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The ELECTRICAL REVIEW

FOUNDED 1872

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Advertisement Index see page xliv. *Official Notices see Sup. 32.*

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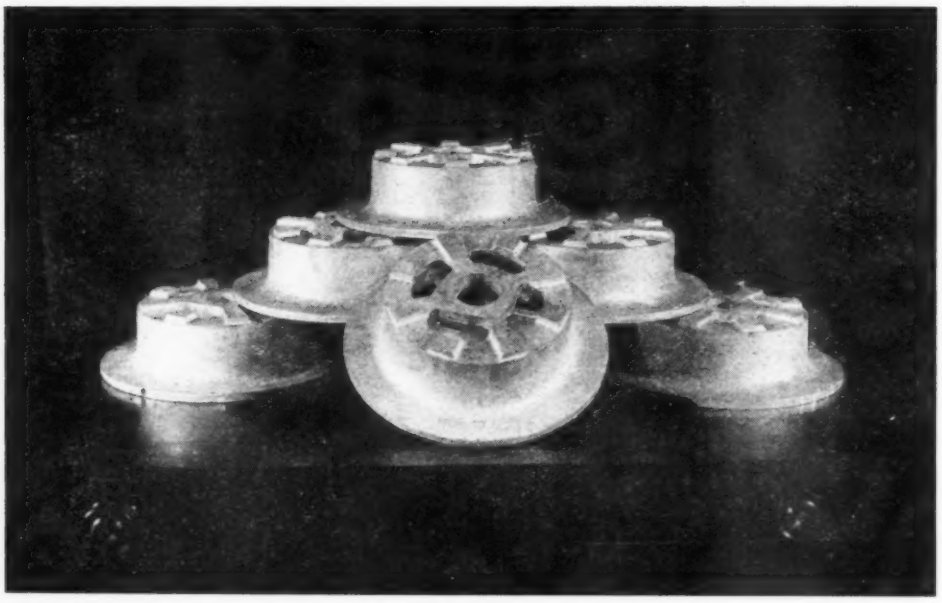

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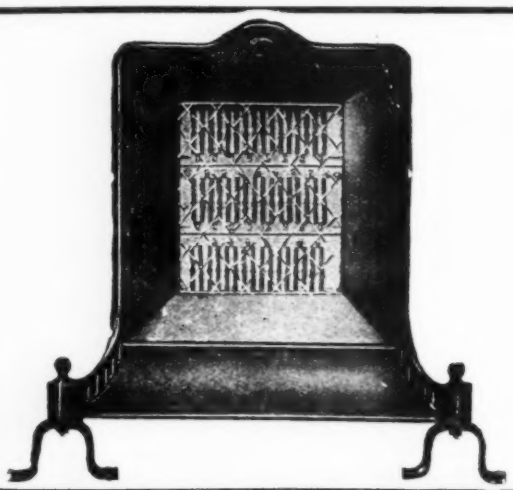

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The

Electrical Review

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LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
The Electrical Industry and the Labour Situation ...	601
Off-peak Loads	602
Belgium's Promising Future	602
Telegraphic Traffic	603
Protecting French Industry	603
"Finsbury" Threatened	603
Ratio and Phase-error Tests on Current Transformers, by G. W. Stubbings (*Illus.*)	604
Efficient Management...	607
Public Supply for Filament Lighting, by J. Henderson (*Illus.*)	608
Chilean Electrical Enterprise	610
New Electrical Devices, Fittings, and Plant (*Illus.*) ...	610
Parliamentary	611
Radio-telephony on Railway Trains, by E. J. Collier	612
Correspondence—	
Looping-in	613
Plumbing Joints	613
Single-phase Induction Motors and the Starting Problem	613
Condenser-type Bushing Insulators	613
Pyrometric Control	614
Bakers' Oven Hand Lamps	614
"What is Electricity?"...	614
Reviews	615
Business Notes	616
Lighting and Power Notes	619
Tramway and Railway Notes	620
Telegraph and Telephone Notes	620
Radio Notes	621
Contracts Open and Closed	621
Forthcoming Events	622
Notes	622
Institution Notes	623
Our Personal Column...	624
New Companies Registered	624
Official Returns of Electrical Companies	625
City Notes	625
Stocks and Shares	627
Market Quotations for Chemicals and Metals	628
Some Ill-considered Aspects of Trading Agreements	629
A Universal Meter for Electric Power, by B. H. Smith (*Illus.*)	631
The Electrical and Engineering Exhibits at Wembley (*continued*)	632
The Cable Accessories Co.'s Works (*Illus.*)	633
British Prospects in Portugal	634
The Registration of the Electrical Contractor, by Alexander Lindsay	635
Power-circuit Interference with Telegraphs and Telephones, by S. C. Bartholomew (*Illus.*) ...	636
The Barton Power Station, by H. N. Allott and S. L. Pearce	638
Dalmarnock Electricity Works, by William Burnside	638
Legal	639
Published Specifications	640
Contractors' Column	Advertisement page xxx

The Electrical Industry and the Labour Situation.

IN the course of his interesting speech, reported on another page of this issue, Sir Philip Nash, chairman of the Metropolitan-Vickers Electrical Co., Ltd., felt compelled to qualify his remarks on the prospects of future business by a reference to the labour situation. The growing restlessness which has been observable in other departments for several months past has now reached the electrical and allied industries, and applications are before the Employers' Federation for increased wages. Sir Philip, earlier in his speech, had shown the handicap under which the British electrical industry was operating—due to peculiarly adverse conditions in respect of world competition—at a time when there were signs of improvement in activity which under normal conditions might be expected to bring advantage to our industrial concerns. The speaker held that the prevailing conditions were themselves an appeal to workers and employers to put their heads together "to ascertain whether increased wages can be granted, and at the same time the cost of production be safeguarded from advancement."

Close upon the heels of Sir Philip's speech came the announcement that the Engineering Employers' Federation had sent a circular letter to all the trade unions connected (even in a small way) with the engineering industry, asking them to send representatives to a conference. The object, as stated in the letter, was the formation of a committee "to consider how the present unsettling conditions in the districts may be avoided and the stability of the industry as far as possible secured." There have been signs lately of a tendency on the part of the workers to "talk matters over," but so far we are not acquainted with the results of the Federation's invitation.

To most of us the desirability of a common understanding being reached is unquestionable.

The difficulty seems to be mainly one of ways and means for arriving at agreement as a result of a general appreciation of the nature of the problem that confronts us. We hope that Sir Philip's account of the handicap and of the world market situation will be studied by all parties, employers, employed and, may we add, by legislators too. There is little doubt that the employers and employed will "put their heads together" in one sense when the wage demands now on the table come to be considered; there will, we hope, be serious discussion regarding what the industry can afford to pay, and as to the possibility of giving a better output for wages demanded, thus enabling producers so to face conditions at Home and abroad as to ensure prosperity, maintaining and increasing the employment of our population.

We are heartily in favour of heads being "put together" if they are the right heads, and if they have genuinely at heart the desire to do what is good for the whole industry from which, whether as employés or as shareholders, they look to secure a livelihood. But it will not help matters in the least to press for higher wages without taking into account the factors that are operating against us all just now. The committee suggestion of the Engineering Employers' Federation seems to us to be a practical one, and we hope that the Unions will see the wisdom of adopting it. Both sides will, of course, have to throw every card on the table; there must be no lack of frankness if there is to be freedom from suspicion.

There is a danger of the word "conference" becoming almost as discredited as that other word "reconstruction," and it does not fill us with surprise that the Minister of Labour has turned down the request of the National Alliance of Employers and Employed for the Government to call together another "National Industrial Conference" of Employers' Associations and Trade Unions "to consider action to anticipate and avoid threatened industrial disputes." While we wish well to every effort that may be made to deal with the national industrial problem as a whole, we despair of success being reached along that line. The conditions in different industries are so dissimilar that it is not possible to lay down even general principles which can be applicable to all. You cannot practise idealism on a trade that is struggling for existence without courting disaster. It is better for the Government to leave the matter for spontaneous action on the part of the employers and the employed if there is to be a general conference. The Minister of Labour expresses the opinion that the right course is to take every possible step in the various industries to encourage the formation of joint bodies through which the employers and workpeople may co-operate in the settlement of working conditions and all other matters in which they have a common interest, and to leave the summoning of a large national conference to the two parties "when they consider such a step to be desirable." Yet, notwithstanding what we have said, we have always to bear in mind that the maintenance of prosperity in our national industries, while a matter of immediate concern for the two parties, is also a matter vitally affecting a third party—the public—who are supposed to be safeguarded by Government, that is, when we have a Government that governs.

Off-peak Loads.

Much is said of super-stations, high pressures and temperatures, pulverised coal, and other means by which it is hoped to increase the efficiency of generation of electricity, and these endeavours to economise fuel are undoubtedly most commendable. But one is apt to lose sight of the fact that the heavy fixed charges in most cases are largely responsible for the high price of electrical energy—high, that is, compared with what it might quite conceivably become. Mr. J. W. Beauchamp very opportunely drew attention to this fact at the Batti-Wallahs' dinner the other day, when he declared that the right way to cheapen electricity was by levelling-up the load curve. It is surprising that engineers, who are keen to effect economies inside their power stations, and who recognise the adverse influence of a low load factor on their generating costs, do so little towards improving the load curve by artificial means. Their efforts to develop the domestic load and other demands likely to increase the diversity factor are worthy of praise, but these are what we may call "natural" loads in contradistinction to those that we have in mind, such as the fixation of nitrogen, the production of calcium carbide, the manufacture of disinfectants by electrolysis, and other chemical industries which can be carried on as side-lines, in the same way that gas-works produce by-products which sometimes yield greater profits than the sale of gas and coke. The industries that can be so conducted in association with the generation of electricity for public supply are, of course, restricted to those which can be shut down during the hours when the normal load is heavy, and so regulated as to fill up the valleys of the load curve as fully as possible. We have been assured that the fixation of nitrogen comes within this category; the production of disinfectant has been carried on at Poplar for many years, on a small scale, and the manufacture of oxygen and hydrogen is particularly well-adapted to the purpose. In our last issue we described a new type of electrolytic cell which has been specially designed for absorbing surplus power, and we understand that already a considerable demand for such plant has sprung up. Hydrogen in recent years has rapidly increased in usefulness; it is used, for instance, in hardening oils and fats, in the production of synthetic ammonia, as a fuel in place of acetylene for cutting metal with the gas torch, and in the manufacture of electric lamps and radio valves. Other applications of hydrogen, of less importance in relation to the absorption of surplus power, are to aviation, the reduction of tungsten and molybdenum oxides, the manufacture of artificial rubies, and possibly the production of synthetic petrol and alcohol. Unfortunately, the demand for oxygen is less active, but given a cheap supply it is probable that new uses would be found for this gas also.

Some engineers may object to transforming their works into chemical factories; but the question is not, or should not be, whether it pleases them, but whether it makes for the public welfare. If by adopting off-peak loads, of no matter what description, they can secure even a 50 per cent. instead of a 25 per cent. load factor, they will earn the praise that Carlyle gave to the man who made two blades of grass grow where one grew before—they will be able to reduce the price of electricity to all consumers by a large fraction, and thereby they will stimulate industry in general, and improve the conditions of living of the community which they serve.

But they will not accomplish any of these things by merely waiting for the demand to come along—they should create it.

Belgium's Promising Future.

In our last issue we summarised a very detailed report on economic conditions in Belgium up to the end of last year that had been issued by the Department of Overseas Trade from the pen of Mr. J. Picton Bagge, Commercial Secretary at Brussels.

In his introductory remarks he contrasted the industrial position with the financial condition of the country as influenced by the reparation question. The improvement in industrial activity is reflected in the unemployment statistics, which show that towards the end of the year only 2 per cent. of factory wage-earners were without employment. Mr. Bagge attributes this satisfactory situation principally to the large export demand, the depreciation of the franc, and in a less degree to the elimination of German competition. He

discusses the question of the permanency of the "boom" and, from the evidence he adduces, it appears that the Belgian economic position is thoroughly sound. It is, of course, foreseen that more stable exchange conditions may check foreign buying, and also that the German metallurgical works will no doubt in time resume competition in the world's markets. But, on the other hand, the report points out that Belgium has rich resources, great capacity for work, marked initiative, and strong powers of resistance. Mr. Bagge states that her manufacturers are not accumulating stocks, but are executing orders solely for immediate or short delivery. Consequently there is an absence of speculation. In these circumstances the country should be in a position to weather any period of depression that may come. The Government has adopted many measures which may be regarded as safeguards for the future. The watchword of "Import less—Export more—Produce more" has been given. An agricultural policy has been drawn up designed to increase the home production of grain and dairy produce. Export business is being carefully organised and conducted, particular attention being paid to South American countries. The Commercial Secretary therefore draws the conclusion that, although the immediate prospects may not be bright, the country, by working ceaselessly and restlessly, is steadily winning its way to the ultimate goal of well-being and prosperity. Electrical output and distribution are being centralised and, on the social side, the condition of the worker is being improved by a system of family allowances independent of wages.

Telegraphic Traffic.

There seems little doubt that the existing unrest the world over and the unsatisfactory state of exchanges have had a harmful effect on the traffics of the telegraph companies. Thus, the Western Telegraph Co. showed receipts for 1922 of £1,551,985 and £1,347,441 for 1923, a decrease of £204,544, and the chairman, in drawing attention to the decrease, stated: "I am afraid we must still look for reduced traffics compared with the last few years." The Eastern Telegraph Co.'s figures for 1921 were £4,062,434 and for 1922 £3,450,688, or a reduction of £611,746. Here, again, the chairman stated: "There has been no improvement in trade as shown by the traffics up to the present, and, in fact, there has been a consistent decrease." The figures for the Direct Spanish Telegraph Co. were £90,678 for 1922 and £80,248 for 1923, a decrease of £10,430. The revenue of the Eastern Extension Co. was in 1921 £2,312,091 and in 1922 £1,939,938, or a decrease of £372,153. The Cuba Submarine Co., the West India and Panama Telegraph Co., the Direct West India Cable Co., the Amazon Telegraph Co., and the Great Northern Telegraph Co. show decreases in revenue of £8,787, £12,624, £3,242, £9,426, and £242,947 respectively, and thus the total decline of all these companies amounts to £1,475,899.

In some cases decreased revenue has been offset, in part, by stringent economy, but it would appear that the large sums expended for new cables will require a considerable amount of new traffic to provide interest on and redemption of new capital. How far this can be accomplished remains to be seen, particularly in view of the efforts of new undertakings providing telegraphic communication entirely free of existing interests. Thus, an Italian company is to lay cables from Italy *via* Spain to North and South America, although it would appear that the new cable to be laid by the Western Union Telegraph Co. from New York to the Azores will provide the connection of the Italian cable at those islands. The Italian company also contemplates laying cables Eastwards.

The Commercial Cable Co. and the Western Union are laying cables to the Azores, and the German company will lay cables from Emden to those islands. If the establishment of direct wireless telegraphic connections between various countries be also taken into consideration, it would appear that competition between various telegraphic interests is to be of a very lively nature in the future. Telegraph rates are likely to become less and the speed of transmission greater, but this may be regarded as of advantage to the commercial community and likely to cement international relations.

Protecting French Industry.

At the recent meeting of the Syndicat Professionnel des Industries Electriques it was mentioned that attention had been paid to the financial and other regulations affecting the scheme for distributing electrical energy throughout the rural districts of France. An application was made to the Senate Commission of Finance, which resulted in the Syndicat securing the introduction into the regulating provisions of the law of a clause tending to ensure the preferential use of French material in connection with works for the distribution of energy. The Syndicat, as representing the manufacturing interests, has now addressed a letter to the interested Ministers and the Prefect of the Department of the Seine, suggesting that public administrations should not place orders with foreign firms except in the "absolute impossibility of finding a French supplier."

"Finsbury" Threatened.

From statements published in various quarters it appears that the Finsbury Technical College is again threatened with extinction. If this indeed be the case, the news will be heard with dismay, not only by every old student of the College, but also by the whole electrical engineering industry. Every technical college acquires in course of time a character and a sphere of utility of its own, and the traditions and attainments of Finsbury have been of the highest.

What are the reasons for the proposed closing of the College? Let them be announced and fully discussed ere it be too late. That the College is unnecessary can never be maintained in these days, when the prospects of the electrical industry are brighter than ever before, and the qualifications of a Finsbury-trained man find so many applications.

The stumbling block apparently is that of finance, and, in our opinion, it would be national folly and a discredit to the electrical industry to allow this obstacle to remain. A grant of £10,000 a year has, we understand, enabled the College to keep going since its fate was last in the balance, but now the powers that be seem reluctant to continue this grant because the cost per student is too high or, alternatively, because the number of students is too small.

There is a distinction, and an important one, between these alternatives. The cost per student might be too high if the expenditure were extravagant over a period of years during which the College was filled; but the lowest expenditure which can be reached, compatibly with efficiency, is not too much, however high it be, for we must have ample facilities for technical training. It is only avoidable or unnecessary expenditure which comes in question, and it should be an easy matter to determine whether there is any such wastage. We believe it will be found that in point of expenditure on equipment, Finsbury is extremely economical, and that the staff salaries are by no means extravagant.

There remains the alternative that the number of students is too low, and therein apparently lies the root of the trouble, which is not that there is no demand or need for the College, but that the uncertainty of a few years ago naturally resulted in many prospective students going elsewhere. We are confident that the continuance of the College is amply justified, and that it would be a national calamity if the College were closed. "Finsbury" would pay to the engineering industries of the Empire a handsome dividend on far more than the £10,000 a year which apparently stands between it and dissolution, and we urge, in the strongest possible terms, an immediate solution of the problem. No institution, however admirable, can stand periodic threats to its stability and, if the enrolments for next session are not to be prejudiced, immediate action is required.

Ratio and Phase Error Tests on Current Transformers.

By G. W. STUBBINGS, B.Sc., A.Inst.P.

The writer has attempted in the following paper to give detailed directions for carrying out tests for the errors of current transformers, by a method which is suited to the resources of test rooms attached to ordinary a.c. supply undertakings. There is no difficulty in carrying out such tests with the apparatus available in the more highly equipped test rooms or the well-known standardising laboratories, nor is there any lack of published information as to the various methods of so doing. The standard methods are based on direct measurement of the errors, and are not suited to the smaller test rooms; for such the method of comparison with a standardised transformer, of similar ratio to the one whose errors are to be determined, is now promising, and can usually be carried out with the apparatus available in such test rooms.

The effect of current transformer errors on the accuracy of supply meters is too well known to require more than a passing mention, and although testing meters with their transformers is the best practice, it is frequently more convenient, especially when adjustments have to be made, to test the meter without its transformers, making suitable allowance for transformer errors. Testing high-capacity 3-phase meters with transformers is not usually possible with the resources of the average test room, and to test such a meter on a 3-phase circuit without its transformers is, if the errors of such transformers can be determined, probably the best compromise. It is therefore hoped that the following notes will be useful to those engaged in the smaller test rooms.

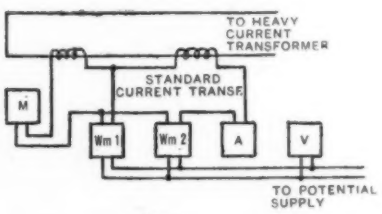


Fig. 1.

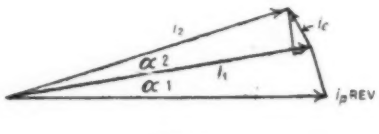


Fig. 2.

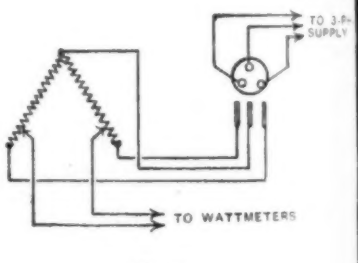


Fig. 3.

General Principles.

The method of testing current transformers which is to be considered in detail consists in the direct measurement of the difference between the ratio and phase errors of the transformer under test, and those of a standard transformer of the same nominal ratio. Portable current transformers for use with 5-ampere sub-standard wattmeters form part of the equipment of most a.c. test rooms, and if the errors of these transformers when loaded with a wattmeter and ammeter are determined in a standardising laboratory, these errors may be considered to remain constant over long periods, provided the transformers are properly used. Modern portable transformers usually have several primary ranges, either by windings arranged for series-parallel connection, or, for heavy primary currents, by winding a primary to suit the conditions of the test. The type of multi-range transformer having both a sub-divided primary for smaller currents, and an aperture in the core through which a heavy cable can be passed, for the higher ratios, is most convenient.

The connections for the ratio and phase error tests are shown in fig. 1, from which it will be seen that the primary windings of the two transformers are traversed by the same current, which will, as a rule, be supplied for the low voltage testing transformer. The secondary windings are joined in series, the meter or other apparatus being supplied by the transformer under test, and a wattmeter and ammeter being included in the circuit. A second wattmeter, preferably of low current capacity, is connected, as shown, in such a way that its series coil is traversed by the difference between the currents furnished by the secondary windings of the two transformers. The vector diagram of the various currents is given in fig. 2; i_p is the reversed primary current vector, i_1 the secondary current of the standard transformer, leading i_p by a small angle α_1; i_2 is the secondary current of the transformer under test, smaller in magnitude than i_1 and leading i_1 by an angle α_2. The vector difference of i_1 and i_2, shown on the diagram as i_c, is the current in the difference wattmeter series coil.

If this current be combined with a voltage vectorially at right angles to i_1, the wattmeter will read $v_1 \times i_c \sin \psi$, where ψ is the angle between i_c and i_1. Calling this reading w_1, we have $w_1/v_1 = i_c \sin \psi = i_1 \sin \alpha = i_1 \alpha$ very nearly, α, the difference in phase angles, being in circular measure. From this it follows that $\alpha = w_1/i_1 v_1$. By combining i_c in the wattmeter with a voltage in phase with i_1, a reading corresponding to $v_2 \times i_c \cos \psi = w_2$ is obtained; and as $i_c \cos \psi$ is very nearly equal to the difference in magnitude between i_1 and i_2, we have the fractional difference in ratio error as $w_2/i_1 v_2$.

Generally the errors of the transformer under test will be greater than those of the standard transformer. This point can conveniently be verified by so arranging the connections that a resistance of about 1 ohm can easily be introduced into the connection between the transformer under test and the difference wattmeter. The introduction of this resistance into the circuit will increase both ratio and phase errors of the transformer, and if these were originally greater than those of the standard, the readings of the difference wattmeter for both ratio and phase tests will be increased. If, however, these readings are diminished or reversed by the introduction of the additional resistance, this will indicate that the errors of the transformer under test were less than those of the standard.

Accuracy Obtainable.

The success of the method plainly depends upon the ability to measure the two components of the small difference current of the two transformers, and upon the means available for exciting the wattmeter with potentials of the requisite phases. It is to be noted that, as the errors are measured directly, a great accuracy in these measurements is not essential. The difference in the ratio errors of the two transformers will not as a rule exceed two per cent., and if there be a 5 per cent. error in this measurement, the effect on the ratio error so determined will be 0.1 per cent. only. Slight errors in phase adjustment are not of vital importance. If,

for instance, in the determination of ratio error there be a defect of exact phase coincidence of the exciting voltage of the difference wattmeter with that of the current i, represented by a small angle β, the wattmeter will measure

$$i_e \text{ V } \cos(\psi \pm \beta) = i_e \text{ V } (\cos\psi \pm \beta \sin\psi).$$

The fractional difference between the real and the observed ratio error will generally be of the same order as the radian measure of the angle β. An error in phase adjustment of 5 degrees will not occasion a difference of more than 0.2 per cent. between the observed and actual difference in the errors of the two transformers, and it should be possible to make the requisite phase adjustments within much closer limits than ± 5 degrees.

If we assume for the moment that there will be a difference of about 2 per cent. in the errors of the two transformers, the current to be measured by the difference wattmeter at the full load of 5 secondary amperes will

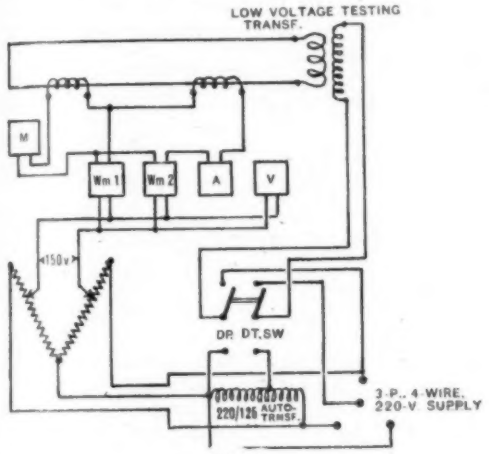


Fig. 4.

be of the order 0.1 amp. This current will decrease as the load is diminished, but not proportionally, being relatively greater at the lower loads. If a one-ampere wattmeter be available, and it be possible to use the overload capacity of the pressure coil by using an exciting voltage, 50 per cent. in excess of the rated voltage, a deflection of 15 per cent. of full scale will be obtained at full load, and, for a similar difference of 2 per cent., a deflection of 3 per cent. will be obtained at one-fifth of full load. The possibility of obtaining the maximum excitation voltage depends upon the method of phase shifting used, and in arranging the test this point should be carefully borne in mind. By the use of a spring-off push-button switch in the pressure circuits of the wattmeters it may be possible even to use double the rated voltage, if this is applied only for a sufficient time for the readings to be taken. With the conditions just considered, a deflection of $\frac{3}{4}$ per cent. of full scale will correspond to a difference in error of 0.1 per cent. at full load, whilst at one-fifth load this difference will be indicated by a deflection of 0.15 per cent. Even this latter reading will be quite observable on a good instrument. With a 2½-ampere wattmeter, the conditions are not as favourable. Assuming that 0.1 per cent. of full scale is the smallest observable deflection, this corresponds to a current of 0.0016 ampere with an exciting voltage 50 per cent. in excess of rated voltage. The smallest observable difference in the errors of the two transformers at one-fifth load is therefore 0.16 per cent. A low current wattmeter is therefore particularly desirable for this test, but even with a 2½-ampere instrument, results of considerable utility can be obtained.

Indications of the accuracy of phase adjustment of the exciting voltage of the difference wattmeter are relatively easily obtained for the phase error test, when this voltage is in quadrature with the current i_1. This indication is given by the wattmeter, W_{m_2}, carrying the total secondary current of the standard transformer, reading zero. The inherent phase errors of modern wattmeters is so small that, if this condition is satisfied, the defect of the exciting voltage from exact quadrature with the current i_2 will be quite negligible. The effect of a small error in the phase adjustment of the voltage has already been shown to have a trifling effect upon the final results of the test. These considerations are not put forward to suggest that due care should not be exercised in carrying out the test, but to show that if the apparatus available is not such as to allow a very close adjustment of the phase of the exciting voltage so as to obtain a reading of exactly zero on the total current wattmeter, the accuracy of the tests will not necessarily be seriously vitiated thereby. The conditions for the determination of ratio error require that the exciting voltage of the difference wattmeter be in phase with the current i_2, and this condition is not so easy accurately to obtain as that for the phase error determination. If the supply voltage be quite steady, and the potential on the wattmeters be constant for all phase positions, as when a phase-shifting transformer or movable stator alternator is used, the condition can be realised by obtaining by phase adjustment a maximum reading on the total current wattmeter W_{m_2}, the magnitude of the potential and current remaining constant. If the supply voltage be unsteady, this method is not of much use. A single-phase power-factor meter, excited by the same current and voltage as the wattmeter W_{m_2}, provides a very convenient means of making the adjustment, especially if the instrument have a degree scale, as well as a cosine scale. Adjustments are also easy when using a phase-shifting transformer with which the movement of the rotor can be accurately observed. Failing these methods, it is best to arrange for the voltage system on the arrangement from which the potential circuits are supplied, to be rotated through some known angle, the adjustment remaining as for the phase-error test. If this phase shift can be made approximately 90 degrees, as might be possible with a two-phase supply, the required condition will be satisfied. Generally, if the phase shift be a known angle θ, the difference wattmeter will read—

$$i_e \sin(\psi \pm \theta) = i_e (\sin\psi \cos\theta \pm \cos\psi \sin\theta),$$
$$\text{then } W_2/i \text{ V} = W_1/i \text{ V} \times \cos\theta \pm r \sin\theta$$
$$\text{whence } r = \pm (W_2 - W_1 \cos\theta)/i \text{ V} \sin\theta.$$

W_2 and W_1 being the readings of the difference wattmeter for the ratio and phase-error tests respectively, the current and pressure remaining the same for the two tests. Details of the application of this method will be discussed later.

Methods of Phase Adjustment.

As phase-shifting transformers and movable stator alternators are luxuries found, as a rule, only in the larger test rooms, it is proposed to deal in detail with methods of phase adjustment which are applicable to the tests

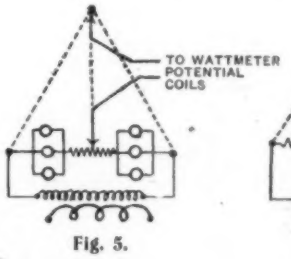


Fig. 5.

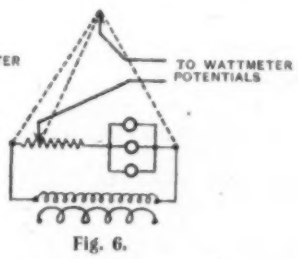


Fig. 6.

just described, and which require only such apparatus as is to be found in the ordinary test room, or can easily be obtained. With a 3-phase supply, the writer has used the arrangement shown in fig. 3, and has found it very convenient. The arrangement consists of two slide rheostats, capable of being connected across the supply voltage, and carrying at this voltage about 1 ampere. The two rheostat coils are joined up to a 3-pin plug which engages with a 3-pole socket energised from the supply voltage. The potential supply to the wattmeters is taken from the sliding contacts of the rheostats. It is readily seen that by adjustment of these contacts alone, 120 degrees of phase shift are obtainable, and by manipulation of the 3-pin plug, complete adjustment through

360 degrees is possible. Further, the magnitude of the voltage as well as the phase is under control. If the slide rheostats be supplied at a voltage in excess of the rated voltage of the wattmeters, it is possible to adjust the magnitude of the wattmeter potential to make full use of the overload capacity of the pressure coils, and so to obtain the maximum readings on the difference wattmeter. When using this method of phase adjustment, the low-voltage testing transformer was supplied from the red and white phases of the 3-phase low-pressure supply, and for the phase-error test the adjustment was so made as to give zero reading on the total current wattmeter. For the ratio test, the phase of the current was shifted by 90 degrees by changing the supply to the low-voltage transformer to blue and neutral, the voltage being stepped up to approximately the original value by an auto-transformer. The complete connections are shown in fig. 4, and the arrangement proved to be very convenient, and enabled the tests to be carried out quite quickly.

Although the use of slide resistances capable of connection to the low-pressure supply voltage forms the most convenient method of phase adjustment, rheostats of

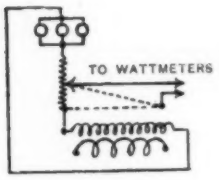


Fig. 7.

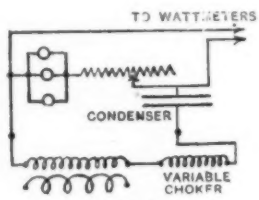


Fig. 8.

lower ohmic value, such as are used for current adjustments, can easily be adapted to give the required results. Fig. 5 shows an arrangement for use with 3-phase circuits. A circuit made up of two banks of three or four lamps in parallel, together with a slide rheostat is connected to the same two phases as supply the low-voltage transformer, while the wattmeter potential circuits are connected to the third phase and the sliding contact of the rheostat. Sufficient current should be passed to give a fair drop on the slide resistance, as this will enable a good range of phase adjustment to be made. This arrangement will be suitable for cases where there is considerable resistance either in the primary or the secondary circuits of the low voltage transformer. If circumstances be such that the secondary current lags considerably behind the primary voltage, the connections can be modified, as shown in fig. 6, this modification suffering from the disadvantage that the magnitude of the wattmeter voltage alters as the phase adjustments are made.

To obtain the ratio error, an alternative to the method of altering the phase of the supply to the low-voltage transformer is to rotate the phase of the voltages supplying the wattmeters and potential sliders through 120 degrees. This can be conveniently done by the use of a 3-pin plug. If the rotation be such as to increase the reading of the difference wattmeter for a reading w_1 obtained for the phase error test to w_2

$$\frac{w_2}{v} = i_e \sin(\psi - 120^\circ) = i_e \cos(\psi - 30^\circ),$$

$$w_2/i\,v = \tfrac{1}{2}\sqrt{3}\,r + w_1/2\,i\,v,$$

$$\text{whence } r = (2w_2 - w_1)/\sqrt{3}\,i\,v.$$

When a two-phase supply is in use, the arrangement shown in fig. 7 can be used. From this a voltage will be obtained slightly lagging that in quadrature with the voltage supplying the testing transformer, which will meet the actual conditions. The ratio test is best taken by changing over the supply to the testing transformer to the other phase, thereby obtaining the required phase shift of approximately 90 degrees.

When a single-phase supply only is available, the phase adjusting arrangements are not by any means so easy to make, and some phase-splitting device becomes necessary. An arrangement suitable for these tests is shown in fig. 8. Here the current in the primary windings of the current transformer is made to lag behind the supply voltage by a large angle by using a choke coil in series with the primary (fig. 9). A resistance composed of lamps and a slide rheostat is joined up to a condenser in the manner shown, and the wattmeter pressure coils are connected across the resistance. By altering the position of the moving contact of the slide rheostat, the phase of the wattmeter voltage can be adjusted. For the purpose of this test, 2-microfarad telephone condensers will be found very convenient, and 30 of these will have an impedance of approximately 50 ohms on a 50-cycle supply. It will possibly be best to make rough adjustments of the phase of the current by using an adjustable lamp bank either in series or in parallel, with the choking coil in series with the primary of the low voltage transformer. As exact values of the main current are not required, there will be no objection to this procedure, final adjustments to the phase of the voltage being made by the slide rheostat. To obtain the ratio test, the potential to the wattmeters is changed over to the supply voltage. If v be the latter voltage, v_1 the voltage for the phase error test, and v_2 the voltage across the condenser, then—

$$v_2 = \sqrt{v^2 - v_1^2},$$

and $w_2/v = i_e \sin(\psi - \gamma)$ where γ is the unknown phase angle between the wattmeter voltages in the two tests. Then $w_2/i\,v = i_e/i \times (\sin\psi\cos\gamma - \cos\psi\sin\gamma)$,

$$= w_1/i\,v_1 \times v_1/v - r\,v_2/v,$$

whence $r = (w_1 - w_2)/i\,v_2 = (w_1 - w_2)/i\sqrt{(v^2 - v_1^2)}$.

If the change-over to the supply voltage reverse the reading of the difference voltmeter, w_2 will be negative in the preceding result.

It need hardly be said that it will not be legitimate to measure the voltage v_2 across the condenser with a moving iron or a dynamometer voltmeter, as the resistance of these instruments will be sufficient to disturb the quadrature relationship of the voltages v_1 and v_2, upon which the correctness of the above investigation depends. If, however, an electrostatic instrument be available, the voltage v_2 can be directly measured, when the calculation will be much simplified.

It will be readily seen from the preceding that the success of the method depends largely upon the ability to obtain good readings on the difference wattmeter. The accuracy of this instrument, or of the total current wattmeter, are not of great moment, provided they are reasonable, nor will a slight unsteadiness of the supply voltage occasion much difficulty. Every effort should be made to obtain the maximum reading possible on the

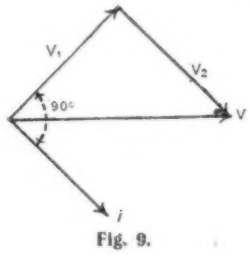


Fig. 9.

difference wattmeter. It is unfortunate that with most of the methods of phase adjustments the magnitude of the voltage is not under control. The possibility of arranging for the maximum excitation voltage that it is safe to apply to the wattmeter will depend upon the apparatus available in the test room in which the tests are being conducted, and upon the ingenuity of those carrying out the test. Generally speaking, however, there should be no difficulty in determining the errors of current transformers to at least as high a degree of accuracy as that obtainable in other a.c. tests.

German Trading Operations in Turkey.—It is reported in Germany that the A.E.G. and the firm of Otto Wolff, of Cologne, are in course of establishing a joint sales organisation in Turkey for their electrical and iron and steel products.

Efficient Management.

By J. L. C.

In reviewing the electrical manufacturing industry over the past 30 years, one is impressed with the magnitude and vast ramifications of many present-day concerns when compared with the modest establishments of earlier days.

The purchaser was then influenced in placing his order, by consideration of the relative merits of different makes and their reputation for reliability; ideas varied as to design and construction, permissible temperature, overload capacity (if any), and so on.

Present-day practice has become so standardised that in many cases there is little or nothing to choose between the quality of the goods supplied by one manufacturer or another, and successful trading depends more and more upon the efficient management of the business.

There is, in my opinion, considerable scope for improvement in this direction, and I propose to offer some criticisms and suggestions which I trust will prove helpful.

I will commence with the selling organisation, which I may say is usually the best managed side of most businesses to-day. A point of primary importance is that all estimates or quotations should be concise and complete; a quotation which omits some essential information asked for in the inquiry is useless, and either involves supplementary letters on both sides or the loss of the business, should the prospective customer cast it aside without troubling further. This is what usually happens if other satisfactory offers have been received.

The representative or traveller ought to have a general technical knowledge and some practical experience of the machine or apparatus he attempts to sell, otherwise he wastes the time of all parties, and probably only obtains such orders as his employers would get in any case.

Follow-up letters unless they contain definite supplementary information should be sparingly used, and printed reply postcards or forms dispensed with altogether; they are seldom effective and may do more harm than good.

Selling requires tact, and too much persistence can be very detrimental, as we have all suffered at times from over-frequent visits of travellers and a stream of perfunctory follow-up letters. A busy man may sometimes avoid sending inquiries to such firms, although their goods are known to be perfectly satisfactory.

It is no doubt extremely useful for a manufacturer to know why an order has been lost and to which of his competitors it has gone, but such information is not always easily obtained, and it must not be pressed for unduly. The purchaser may be reluctant to disclose having placed the order on more favourable terms in case the price may be raised against him next time; in these days of trade combinations and associations such a contingency is not improbable.

The best means of judging whether or not competition is being effectively met, is to compare the aggregate sales of each department per month or per quarter, making due allowance for seasonal requirements and general trade conditions.

Having obtained an order or contract, the sales department usually has no supervision over its execution, but transfers its attention to other new business, and it is from this point onwards that there is the greatest scope for improved methods.

All orders, except those which can be executed on the day they are received, should be acknowledged, and in doing so the customer should be given as much information as possible; a printed form or postcard merely stating that the order has been received is inadequate.

The acknowledgment should indicate to the customer when delivery can be given, or, if a date is stated on the order, whether it can be complied with, and also confirm (if in order) any special instructions it may contain. The customer wants to know, as soon as possible after placing an order, that his requirements can be supplied within the time permissible; if delivery is expected from stock, and it is found that the stock has been exhausted, the wisest policy is to make a frank statement of the position and, at the risk of having the order cancelled, give an honest promise of delivery; this is far better than keeping the customer waiting from day to day expecting delivery, and finally exhausting his patience.

Some firms, in acknowledging orders or contracts, quote a reference number to be used in all future communications, and this is an excellent system, particularly when the transaction is likely to be protracted and involve correspondence; in any case the system is to be commended as, even if only a telephone inquiry has to be made, it is a great convenience to be able to give the manufacturers their own reference which will definitely identify the order with the least possible delay.

A competent staff should be employed to deal with orders, as it is just as important to retain a customer as to obtain a new one, and lavish expenditure in sales organisation, advertising and propaganda work is too often nullified by incompetence and negligence in the order department.

Accuracy, courtesy, and prompt attention must be insisted upon, and the customer should feel that his requirements, whether large or small, are receiving personal attention. It is well worth while to pay a little more for a capable staff than to spend money in rectifying mistakes and regaining the confidence of dissatisfied customers.

Many large concerns lose orders because the purchaser cannot depend upon them for prompt and efficient service, and he is consequently driven to deal with wholesale houses or intermediaries on account of their better organisation; the wholesale houses could not exist without efficient management.

Finally, I should recommend every big company to have an inquiry department in charge of an experienced member of the staff, not necessarily a trained technical man, but one who has a good general knowledge of all branches of the business and a quick intellect, as well as courtesy and tact.

Such a department would deal with callers and direct them to the proper department, but, more important still, it would act as a clearing house for telephone messages. For example, if an inquirer wanted a quotation or any information such as whether a certain article was in stock or how long it would take to supply, he would state his requirements to the inquiry department, which would then relieve him of further trouble by obtaining the information required and telephoning it to him, or, if advisable, requesting the department interested to speak to him.

Such procedure would minimise waste of time and reduce the loading on the telephone lines; the practice of asking the inquirer to hold the line, whilst he is switched on to one individual or department after another, is an obvious example of unbusinesslike methods, and yet it is very prevalent to-day.

Orders for standard articles are often placed with the firms which are easiest to communicate with, especially if delivery is urgent. For example, some standard machines or accessories are wanted from stock, and an inquiry is made by telephone of firms A, B, and C; from firm A we get the engaged number signal, and therefore decide to try them again later if the other two are unsatisfactory; from firm B we get a reply that they will communicate with us later; from firm C we get a satisfactory reply at once, and give them the order to save further time and trouble.

The efficient and prompt handling of telephone inquiries will do much to facilitate business and promote good relations with customers.

Public Supply for Filament Lighting.

By J. HENDERSON, M.C., B.Sc.

Up to the present time the energies of our valve manufacturers have been almost entirely devoted to the manufacture of low-current consumption valves as a means of eliminating the accumulator, and the nuisance of its frequent charging. In some cases this has been attended with indifferent success, as some of the valves are not suited for use in any but skilled hands. It should not be beyond the ingenuity of the makers of receiving sets to make these in such a way that they could be used with a 6-volt battery, public supply continuous current, or public supply alternating current. This is more essential, as it is becoming standard practice on the part of many manufacturers to fit a power amplifying valve as the last valve. This prevents the use of any other method of lighting the filaments, as

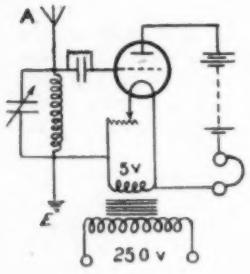


Fig. 1.

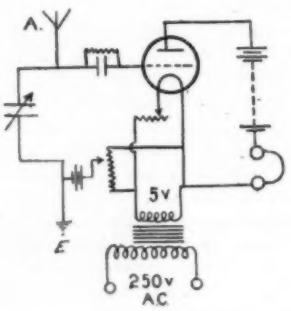


Fig. 2.

dull-emitter valves of low current consumption cannot be worked in the other positions off a dry battery. It is the purpose of the present article to show how all standard sets may be made to work off any public supply, whether alternating or direct current.

Alternating current will be considered first, as it is generally much easier to make a receiver work off a high-voltage direct-current supply than off an alternating one. Alternating current has a great advantage over direct current; it can be transformed up or down to any voltage with the utmost ease. In considering its application to filament lighting, therefore, we can replace the accumulator with a static transformer wound to give the necessary voltage. This is generally about five volts, but the secondary should be arranged to give the exact voltage required, as best results are got when the filament rheostats are all cut out or short circuited.

The principle of valve reception lies in the fact that any hot body emits electrons. We therefore expect that the filament will continue to emit electrons no matter how it is heated, and that it will emit these in a steady stream, provided the filament is maintained at a constant temperature. It is the latter consideration which introduces most of the trouble in the attempt to use alternating current for filament lighting.

The instantaneous values of the current vary according to a sine function of the time, and this function passes through zero twice in every cycle. Round about the instant when the current is passing through its zero value, the filament drops a little in temperature causing a slight drop in the electron emission to the plate. We get in the telephone receivers, therefore, a "hum" or "purr" which has a frequency of twice the supply frequency. This is exemplified in the well-known flicker so prevalent and annoying to unaccustomed eyes on 25-cycle supply systems. This drop in filament temperature is a difficulty which cannot be altogether surmounted, but, luckily, with the very high degree of vacuum used in modern valves, the trouble is not great and the drop in temperature is not so much as to cause serious inconvenience, especially on the higher frequencies. Soft valves will not operate quietly on a 25-cycle supply, but on 50 cycles almost any valve will give good results, provided the receiver is not operated too close to oscillation point. Almost any type of power amplifying receiver worked off a crystal set will give perfect results.

The double frequency "hum" or "purr" may be introduced in two other ways, and it is with these that the chief concern lies in the design of a receiver for use on alternating current supply. The "hum" may be introduced by way of the grid circuits, or through the plate circuits of a valve receiver. Suppose a receiver to be connected in its normal way, as shown in fig. 1, with a transformer of suitable ratio in place of the battery, a very decided "purr" is at once evident in the telephones. If the temperature variation in the filament is left out of account, the reason for this is that the grid circuits are connected to the positive and negative ends of the filament alternately during each cycle of operations, and a variable voltage of six volts is being applied to the grids. The obvious correction for this is to connect the grid circuits to a point of constant potential. The centre point of one of the filaments fulfils this conditions, but as this is not available, an artificial neutral point must be made by means of a potentiometer. This potentiometer should be adjusted each time the filament rheostat is varied. As half the filament is always negative to the grid, the valves used in this way will not amplify properly, and distortion will take place due to grid currents.

If a three-volt grid battery is connected, as shown in fig. 2, it will be found that the valves will amplify perfectly, and little trouble will be experienced with "hum." As it would certainly not be convenient to include a potentiometer in every set, the best and most convenient method is to connect the grid circuits to the centre point of the winding of the transformer secondary. Manufacturers do not seem to recognise the necessity of bringing out the ends of the grid circuits. Generally, the high-frequency and detector valve grids should be brought to one terminal, and the low-frequency grids to a second terminal, thereby permitting

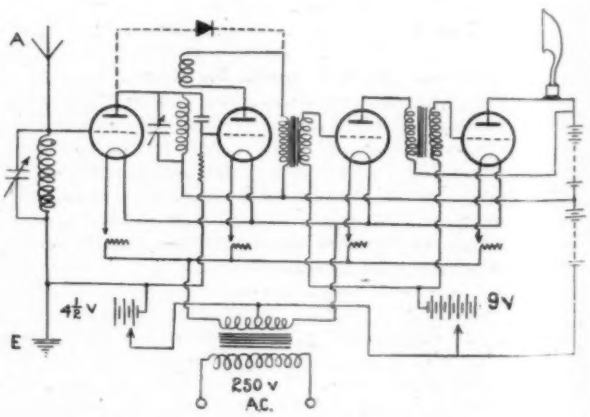


Fig. 3.

the use of different plate voltages for high- and low-frequency amplification.

The transformer secondary should be most carefully wound. It should be wound in one layer of wire of sufficient cross section to carry current for four or five valves, and the exact centre should be tapped, making sure that the numbers of turns on each side are equal. Unless this is done, the transformer is valueless. The secondary voltage should be exactly that required for the valves in use, with the rheostats all out, otherwise the centre tapping will not be a point of equipotential with the filament centres. The negative of the high-

pressure battery should also be connected to this point, and where the high-pressure battery is included in the receiver the negative terminal may be connected permanently to the middle point terminal on the receiver, or conversely, the negative high-pressure terminal may become the centre point terminal.

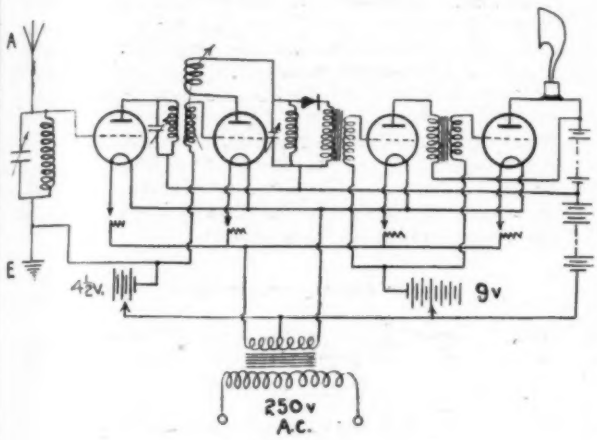


Fig. 4.

Figs. 3 and 4 show the connections of two receivers with which the writer has experimented, and a brief description of the experiments carried out may be of interest to other amateurs who wish to entertain the family with local broadcasting, while saving the battery for experimental purposes. The supply used throughout was 25-cycle alternating current at 250 volts, with a transformer ratio of 250/5. The plate voltage used in all cases was 60-70 on high-frequency amplifying valves, and 100 volts on low-frequency, with a suitable grid bias. The valves used were Marconi-Osram, and Ediswan "R" valves, except in the cases where power amplifying valves were used, and any power valve was found to give exceptionally good results.

The transformer was built up with a core of 1¼ sq. in. cross section, with a window of 5 in. by 3 in. The primary was wound with 3,000 turns of 32 gauge d.c.c. wire, this number of turns being suitable for 25-cycle supply. On higher frequencies the number of turns should be proportionately decreased. The secondary was wound with 70 turns of No. 18 s.w.g. d.c.c., this number of turns being found to give about five volts with four valves on load. The secondary was wound in one layer, and the exact middle point carried to a middle terminal on the transformer box. The apparatus used is shown in figs. 3 and 4. The detector valve

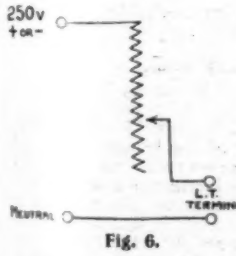


Fig. 6.

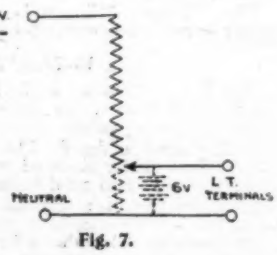


Fig. 7.

in fig. 3 was taken out and a crystal substituted across the tuned anode. On alternating current without reaction, the results on a loud speaker were all that could be desired. On replacing the detector valve, the results were not so good, owing to the fact that without reaction the set was always near oscillation due to bad spacing. A Western Electric loud-speaking equipment was next tackled, using a crystal detector and the well-known 216A type of power valve. The connections were altered as shown in fig. 5. It will be seen that these alterations can be carried out by anyone in a few minutes. The results exceeded expectations and, except on long-sustained notes, it was impossible to tell how the valves were lighted. The four-valve receiver was then completely rewired, as shown in fig. 4, giving 2 h.f. crystal and 2 l.f. With this apparatus Glasgow was as clear on alternating current as on a battery, although a little reaction was employed, and it was found possible to pick up Bournemouth on the loud speaker without "hum," but with a slight degree of "tremolo." The receiver was again rewired to give the arrangement shown in fig. 3, and this time the results were all that anyone could wish for. With L.S.5 valves, or B.T.-H. power valves, the reception was excellent, but only on local broadcasting. Whenever it was attempted to get "distance" the "tremolo" was always introduced, due to excessive reaction. Very much improved results, with and without reaction, should be obtainable on 50 cycles or higher.

It may be stated, in conclusion, that there are now five receivers operated around Glasgow, between three and five miles from the station. These are as follows:—

Two single valve and crystal dual.

One single valve and crystal dual, with one l.f. amplifier.

One crystal and Western Electric loud-speaking equipment.

One four-valve receiver, one h.f. detector, and two l.f.

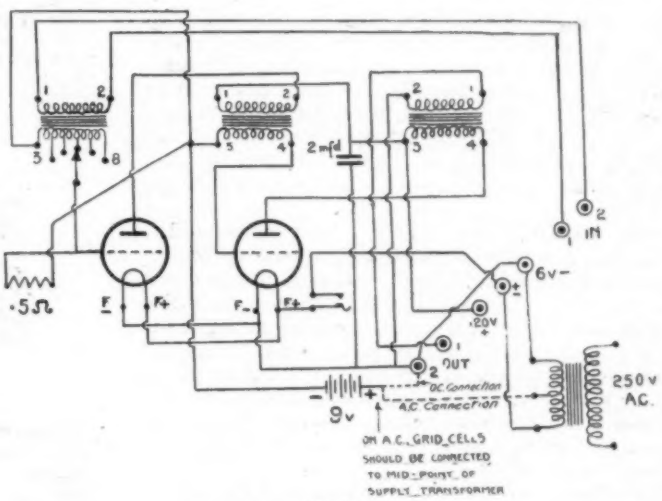


Fig. 5.

It is to be hoped that many readers may be encouraged to try a.c. for filament lighting, especially where the frequency is above 40 cycles.

With regard to d.c. lighting, while easier to carry out, it is more dangerous for the receiver, and it is recommended that the receiver should be earthed through a 2-mF condenser in order to avoid accidents. Once the apparatus is set up with proper switching arrangements, no further trouble or danger is possible. There are two general methods of connection. These may be termed (*a*) series resistance method, and (*b*) potentiometer method.

With a variable resistance in series capable of carrying sufficient current to light the necessary number of valves, it is easy to apply the public supply to lighting purposes. The individual rheostats should be short circuited, and the variable resistance outside the apparatus used as a master rheostat, part of which need not be variable. All valves then light up together when the supply is switched on. Valves must only be changed when the supply is off if the safety of the remaining valves is to be considered. The connections for this are given in fig. 6. The potentiometer method is very similar, but is more wasteful of energy. It has the

advantage that a comparatively small portion of the actual potentiometer need be variable. The connections are shown in fig. 7. It should be noted that a battery may replace the tapping part of the potentiometer, the battery being always in circuit when the wireless receiver is in use. The battery should in this case be discharged every month and given a full charge to keep it in condition. In applying public supply d.c. to filament lighting, the polarity must be known and the valves must be inserted on the side next to the neutral.

If the grid circuits are brought out to suitable terminals, as shown in figs. 3 and 4, it is a comparatively easy matter to apply a battery, or a.c. or d.c. public supply, to the lighting of the filaments, and such a universal set is long overdue from the manufacturers.

Chilean Electrical Enterprise.

Important New Plants about to be Completed.

[From Our Special Correspondent.]

Consideration is being given to the electrifying of a number of Chilean railways serving the more important industrial centres. The economic operation of the Valparaiso-Santiago electrified line, with its short length of but 116 miles, which was opened to public service on July 15th, following upon an official inauguration held on April 16th last, has created a strong feeling in favour of further enterprise of this character.

Among the earliest of the new undertakings to be entered upon will be the line between the important port of San Antonio and the capital, Santiago-de-Chile; that between the port of Talcahuano and the town of Talca; and that between the same port and Temúco, in addition to a branch line from Las Végas to Los Andes, a distance of 28 miles. The latter point is the Chilean terminus of the narrow-gauge Transandine Railway, affording communication between Valparaiso and Buenos Aires, thus linking the Atlantic and the Pacific coasts.

While, up till lately, there has been some hostility shown among certain sections of the public to conversion of further lines from steam to electric power, public feeling is slowly changing, and little further opposition need now be anticipated. The large coal-mining interests are at length becoming interested in the scheme. It has become recognised that while the future use of coal for railway transport may show a decline, the output would be largely increased through the demand created by the fresh lease of industrial prosperity that the country would take on.

The Chilean Government itself is strongly in favour of further electrification, and contemplates the ultimate conversion of the entire broad-gauge lines to this system. The first step taken in this direction will be the electrification of 10 per cent. of the entire road mileage of the State railways' broad-gauge tracks, constituting the most expensive piece of electrification yet undertaken in South America.

It is estimated that there is available for transport and industrial use over 100,000 h.p. of electric power, derived exclusively from the rivers of the country. In the scheme of development British capital is largely interested. The operations of the important enterprise formed some months ago with a capital of £12,000,000, as a set-off against the considerable North American interests already established, has for its principal object the electrical development of the hitherto untouched waterfalls in Central Chile. The Compañia Chiléna de Electrícidad, Limitada, is a combination of the interests of the Compañia Nacionál de Fuerza Eléctrica and the Chilean Tramway and Light Company. It holds valuable concessions for the supply of electricity for light and power to industrial establishments and other utility undertakings.

Satisfactory extensions and improvements have been made at the company's plant, which is located 12 miles from Santiago, and already possesses a capacity of 20,000 h.p. New electrical plant installations will bring up the available power to 28,000 h.p. At Maítenes, on the Colorado River, situated 37 miles from the capital, a large plant, to provide a further 30,000 h.p. is almost completed. The 3,000-volt direct-current system has been adopted as best suited to local conditions. Hydro-electric power will be generated at the Maítenes station (belonging to the Chilean Electric Tramway and Light Co., Ltd.) by means of three 8,125-kVA Westinghouse generators; the plant will ultimately attain a capacity of 30,000 kW. The operations of the company, however, will not stop here. Plans have been drawn up, and officially approved, to build, later on, a hydro-electric station at Puente-de-Cristo, which will develop 65,000 h.p. When in operation this plant will provide, for the first time, an adequate supply of cheap power for manufacturing purposes.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Teleswitch."

The accompanying illustration (fig. 1) depicts the improved "Teleswitch," a remote-control switch, made by Messrs. I. Calvete, Ltd., 11, Little Saint Andrew Street, W.C.2. This small switch is intended to replace the multiple or intermediate switching system and consists of an electromagnet, which, when energised by a couple of dry cells, acts as a relay, closing or opening an independent circuit. The electromagnet is mounted on a base of insulating material and is provided with a mechanical device ensuring a double action (direct and reverse) which moves an armature to the right and left; this armature moves an independent switch and when a current is sent through the solenoid, it puts the switch "on," and the switch remains in that position until the next current through the solenoid puts it "off."

Fig. 1.—The "Teleswitch."

The "Teleswitch" has two circuits, one of them (the electromagnet) is installed in the same way as an ordinary bell (the "Teleswitch" replacing the bell) with as many push buttons in parallel as desired, and the other circuit is wired in the same way as an ordinary tumbler switch (the "Teleswitch" replacing the tumbler switch). Thus any number of bell pushes will control the "Teleswitch" and any one of them will put the lights "on" or "off." The electromagnet consumes practically no current; two small dry cells will last eighteen months.

The "Teleswitch" can be used for controlling a small motor or any other apparatus at a distance.

An All-Porcelain Lampholder.

Mr. J. W. Manley, A.M.I.E.E., "Woodbury," Woodville Road, New Barnet, has designed an "all-porcelain" lampholder possessing points of considerable merit. The components are illustrated in fig. 2. The body of the holder is a glazed porcelain moulding provided with enclosed slots for the lamp pins, and with two axial holes with hexagonal bases for the terminals. There is a threaded shoulder upon which the cover is screwed. The terminals, one of which is separately illustrated, consist of lengths of hexagon rod (about 3/16 in. over flats) turned down to the size of the usual lampholder plungers, a portion of the hexagonal section being left intact. While the lower end forms a plunger the upper end is screwed to accommodate the wire connector. Between this connector and the hexagonal portion a spring is fitted. It will be seen that this arrangement gives a practically solid connection between wire and plunger. The hexagonal part of the terminal rests in the moulded base of the axial hole, the top of the spring bears against a shoulder above which the wire con-

nector rests. When a lamp is put into the sockets the whole of the terminal is forced upwards and is held in tight contact by the compression of the spring. The solidity of the connection is such that the spring carries no current whatever and cannot lose its temper by reason of overheating. The cover of the holder has a screwed projection at the top. This passes through the lamp-shade, which is clamped by the porcelain ring seen in the illustration. The body of the holder can be

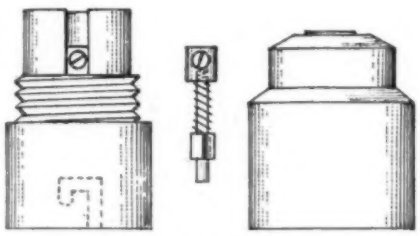


Fig. 2.—An All-porcelain Lampholder.

used in combination with a special porcelain adaptor for making a connection direct to screwed conduit by means of a union joint.

The advantages of the holder will be obvious to the reader, but it may be mentioned that it is non-hygroscopic and that no harm will be done if a strand of the wire is carelessly left out of the connector.

The "Sampson" Accumulator Carrier.

The accompanying illustration (fig. 3) illustrates a device for lifting accumulators for moving them from place to place without inconvenience. It is made of stout non-corroding metal, and when not in use folds up into a very small com-

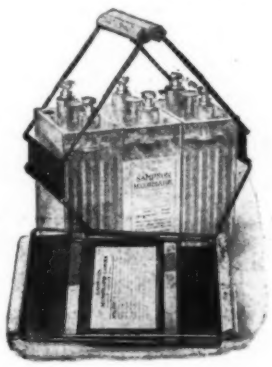


Fig. 3.—The "Sampson" Accumulator Carrier.

pass. Three sizes are made for various ranges of accumulators. The "Sampson" accumulator carrier is supplied by MESSRS. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester.

The "Copes" Feed-Water Regulator.

Some years ago we described the "Copes" feed-water regulating system which employs a tube thermostat controlled by

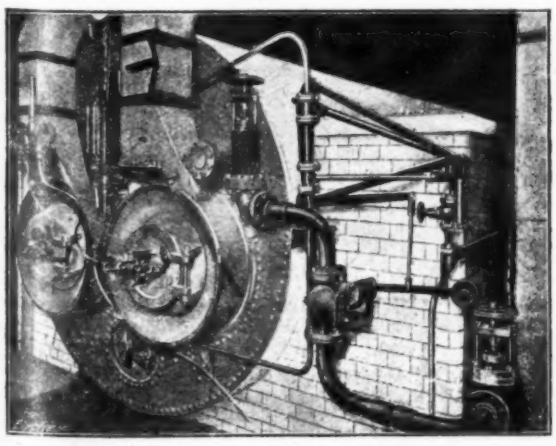


Fig. 4.—The "Copes" Feed-water Regulator Applied to a Lancashire Boiler.

the varying temperatures of steam and water to open or close a control valve as necessary. By this means the feed input is regulated proportionately to the steam output, and a smooth and continuous feed is maintained on steady loads. On falling loads heat is stored and becomes immediately available when the load rises, obviating the forcing of the furnace. Previously it was not possible to equip a battery of cylindrical boilers with the regulator owing to the length of the thermostat. This difficulty has now been got over by the use of a more compact design which can be put into a small space. The accompanying illustration (fig. 4) depicts this new form of the regulator applied to a Lancashire boiler at Messrs. J. Lyons & Co.'s Cadby Hall. The apparatus is supplied by MESSRS. JAMES GORDON & CO., LTD., Windsor House, Kingsway, W.C.2.

Parliamentary.

[By Our Special Parliamentary Reporter.]

Protection of Property.—On April 7th MAJOR KINDERSLEY asked the Prime Minister whether he would bring in legislation applying the principle of Section 4 of the Conspiracy and Protection of Property Act, 1875, now only applied to gas and water companies, to railways, transport services, electricity supply companies, and similar undertakings, upon which the public was dependent.

Mr. RHYS DAVIES, Parliamentary Secretary to the Home Office, said that the Government did not see its way to propose legislation on this subject.

London Traffic Bill.—On April 7th MAJOR KINDERSLEY asked the Prime Minister whether any condition was made during the negotiations in connection with the recent tramway dispute to the effect that the Government would press forward the London Traffic Bill.

Mr. MACDONALD replied that the Court of Inquiry had stated that a measure for the co-ordination of London traffic was the only basis at present suggested for re-opening negotiations. He, therefore, pointed out to the parties that the Government was already pledged to the immediate introduction of the London Traffic Bill and would use its best endeavours to get this measure carried into law.

Tramway Expenditure.—On April 7th Mr. A. M. SAMUEL asked the Prime Minister whether he advised the parties in the recent transport strike that it was the intention of His Majesty's Government to allow the tramway authorities concerned to divert certain expenditure from revenue to capital account; if so, would he state the specific expenditure referred to; and when he proposed to introduce the necessary legislation.

Mr. MACDONALD said it was indicated on behalf of the Government to the municipal tramway authorities affected by the recent strike that in accordance with existing law the Government departments concerned were prepared to consider applications for sanctions to meet the costs of reconstruction by means of loans where such sanctions were required and could be given. So far as he was aware, legislation on this point was not necessary.

Electrical Devices in Farming.—On April 7th Mr. BROWN asked the Minister of Agriculture whether the Ministry would give any information as to the use of electrical devices in farming.

Mr. BUXTON said if the hon. member meant by electrical devices the use of electrical discharges for the purpose of stimulating plant growth, which was commonly called electroculture, this question was being dealt with by a special committee under the chairmanship of Sir John Snell. The committee had issued a series of reports on the subject, summaries of which had appeared in the Ministry's *Journal*.

Hastings Corporation Bill.—This Bill came before a Committee of the House of Lords on April 8th and 9th. It contains a number of usual provisions relating to the Corporation's electricity undertaking, and incorporates the provisions of the Electric Lighting (Clauses) Act, 1899, with regard to deficiencies resulting from working being charged to the local rates. The Hastings and St. Leonards Gas Company opposed the Bill and asked for the insertion of a clause to limit the resort which could be made to the rates.

Mr. W. S. JEEVES, K.C. (who appeared with Mr. Rowand Harker for the Corporation), said that there was a clause in the Bill which provided that all moneys received in respect of the electricity undertaking should be carried to the borough fund, and all payments made from that fund. The Gas Company contended that there should be no deficits; consumers should be charged sufficient to ensure a profit. This was not always possible and it was for that reason that Parliament allowed deficits to be met from the rates. The net deficiency since 1898, when the undertaking was acquired, amounted to £16,563.

The Borough Accountant (Mr. G. R. Butterworth) produced figures showing that £35,232 had been received from the rates and £2,140 contributed thereto. He said that a new station was being erected at a capital cost of £140,000. He estimated that the net profit on the first year's working would be £3,000 and it was hoped to put the station into commission at the end of the present year. It was the policy of the Electricity Committee to pay back in future £2,000 per annum of the

amount which had been taken from the rates, and the reserve fund would gradually be depleted to that extent unless supplemented by further profits. In reply to a question by Sir H. COURTHOPE MUNROE, K.C. (for the Gas Company), witness said that an estimated loss in 1925, as the result of the change-over, would be met from the reserve fund. Mr. ARTHUR COLLINS, chartered accountant, said that this estimate of loss was very pessimistic.

Sir H. COURTHOPE MUNROE said that there had not been an honest attempt to make the undertaking self-supporting, and the time had come when that sort of thing should not be allowed. The Gas Company had to pay a rate in aid of the electricity undertaking, and also had to meet unfair competition.

Mr. W. B. KEEN said that profits still in hand, which ought to have been applied to rates, had not been so applied. A deficit of £7,062 had been deliberately budgeted for in 1925; this meant, in effect, that electricity was to be supplied at nearly 1d. per kWh under cost.

Mr. ROWAND HARKER said that the last occasion on which the suggested clause was inserted in a Bill was in 1914; since then Parliament had refused to insert it—in the case of the Worthing Corporation Bill.

The Committee decided that the Bill should proceed.

London Traffic Bill.—Standing Committee "B" of the House of Commons had this Bill before it again last week. Amendments were carried limiting the scope of the Bill to the Metropolitan Police District, instead of the proposed radius of 25 miles from Charing Cross, although an extension of this area on the report stage was foreshadowed. It was also stated that, on the report stage, if the House desired it, the Minister of Transport would agree to the limitation of the duration of the Bill to three years; in the meantime, the Government would take steps to prepare a scheme for the setting up of a London traffic authority at the end of that time. Various amendments dealing with the detailed representation of the Advisory Committee, which is to be set up to advise the Minister of Transport, were considered. It was agreed to substitute for the words "twelve ordinary and six ordinary and six additional members" the words "such ordinary and additional members as are hereinafter mentioned." An amendment, to provide that the chairman should be elected by the Committee instead of being appointed by the Minister, was rejected, as was a proposal to increase the representation of the L.C.C. from two members to four.

The Committee then adjourned until April 30th.

West Indian Cables.—On April 7th, Sir H. BRITTAIN asked the Colonial Secretary, with regard to West Indian cables, whether the short length of cable which was proposed in the new scheme gave the islands telegraphic communication with the outer world over all-British cables, or whether it simply linked up the islands with cables which were owned by American-controlled companies.—

Mr. THOMAS said that the new cable would connect at Turks Island with the system of the Direct West India Cable Co. and the Halifax and Bermudas Cable Co. The cables of both these companies landed only in British territory, and in time of war would therefore be under the control of British administrations: The companies, though a large proportion of their capital was understood to be owned in the United States, were managed from the London offices, whose staff was entirely composed of British subjects.

On April 8th, the West Indian Islands (Telegraph) Bill, which is for the purpose of providing £400,000 of capital expenditure in order to undertake the cable communication referred to above, was read a second time.

Radio Receiving Licences.—On April 8th, Mr. HARTSHORN informed Mr. Foot that the total number of radio receiving licences in existence on March 31st was approximately 720,000.

Radio Direction-finding Stations.—On April 8th, Mr. WEBB, President of the Board of Trade, informed Viscount Curzon that representations had been made to the Board on the subject of radio direction-finding stations, and this subject had for some time been under the close consideration of the Departments concerned. Under present financial conditions, expenditure must in any case be limited, and invention was proceeding so rapidly that it was difficult to say at present which system would ultimately be best suited to the needs of the mercantile marine. The Board was watching this question very closely, and proceeding as far as circumstances would permit.

Safeguarding of Industries Act.—On April 8th, Mr. WEBB stated that the Government had decided not to introduce legislation to extend the duration of the provisions of Part II of the Safeguarding of Industries Act which dealt with the making of orders on the ground of depreciation of foreign currency. These provisions, and the duties which had been imposed under them, would accordingly lapse on August 19th.

L. & N.E.R. Electrification.—On April 8th, Viscount EDNAM asked the Minister of Transport whether he had any further information with regard to the electrification of the northern suburban lines of the London and North-Eastern Railway Co., or the company's right to veto tube construction north of Finsbury Park.

Mr. GOSLING said that he was informed by the London and North-Eastern Railway Company that the consideration of the problem of electrical traction on the lines to which the question referred was prominently before the directors of the company, but they were not yet in a position to make any definite announcement. He was glad, however, to be able to inform the House that the directors were prepared to waive at once any right they might have to veto any scheme for the construction of tube railways northwards of Finsbury Park, and would give full and fair consideration on its merits to any scheme which might be brought forward, but reserving, of course, their right to oppose on petition any Bill for power to construct such railways which did not meet with their approval.

Broadcasting in Schools.—On April 10th, Mr. TREVELYAN, President of the Board of Education, in reply to Sir H. BRITTAIN, said it was too early to make any estimate of the value of broadcasting as a means of education. Listening-in sets had been installed in a certain number of schools. At present a series of experimental lectures had been organised by the British Broadcasting Company. He had arranged for reports to be made to him on the results of this experiment.

Radio Telephony on Railway Trains.

The G.W.R. Experiments.

By E. J. COLLIER.

FROM time to time experiments have been made to test the feasibility of transmitting telegrams to trains in motion by means of radio telegraphy. At the latter end of 1919 trials were made by the Great Western Railway Co. on trains running between Paddington and Fishguard and Paddington and Bristol. An aerial fixed on top of the coach was used, and signals were picked up with varying success. The recent trials with radio telephony on this Company's system between Paddington and Birmingham showed a distinct improvement in reception, especially when it is remembered that an inside aerial was employed.

An eight-wheeled brake van lighted by gas was used on the journey to Birmingham at the rear of the train. The aerial was a twin T type with an approximate length of 50 ft., roughly 1 ft. below the roof and 6 ft. above the floor. "Earth" was made through the handle of the hand brake, and alternatively, through the vacuum-brake pipe.

The receiver was designed by Mr. C. H. Gardner and constructed at the works of the Midland Radiotelephone Manufacturers, Ltd., of Stourbridge. The set used was a standard "Mellowtone L.R.V." with one extra l.f. valve and additional tuning and switching arrangements.

The high-frequency circuit consisted of two tuned-anode circuits with reaction feed back on to the plate circuit of the first valve. Rectification was accomplished by means of a valve employing a leaky grid condenser. Low-frequency amplification was carried out with the aid of three transformers, the first a 5-1 "Selectone," the second a 2½-1 M.L., and the third a 2-1 "Selectone," grid bias being provided for each valve, and "Mellowtone" adjustable l.f. filter circuits were used for altering the tone value. The l.p. supply was furnished by an "Essex" 6-volt, 50-ampere accumulator, while the h.p. supply was provided by "Hellesen" 99- and 36-volt batteries—90 V on the h.f. side, 60 V on the rectifier, and 120 V on the l.f. amplifiers, a separate 180-volt supply being used for the power amplifiers.

The following are extracts from the log of the journey:—

Paddington: (Left at 4.10 p.m.). Using 5 valves only loud speaker was extremely strong. On leaving the covered station the strength at once rose about 15 per cent.

Northolt: (10 miles.) The train was running into more open country and also climbing steadily. The transmission from the London (2LO, 365 m.) broadcasting station was stronger here that at any other part of the journey. There was slight fading of strength in passing through the larger stations even if they were not covered in.

Gerrards Cross: (17 miles.) Loud speaker still audible above the noise of the train, which was considerable owing to the increase of speed and the emptiness of the brake van. Compared to an ordinary compartment the train noises appeared to be increased by about 400 per cent. and it was

necessary to shout to each other in the van, whereas under similar conditions in a travelling compartment one could, without raising one's voice, converse across the compartment with ease. The strength of the loud speaker was, therefore, much greater than a considerably raised human voice.

Beaconsfield: (4.40 p.m.) Switching on the sixth valve at this point made the loud speaker strength almost unbearable and conversation by shouting was almost impossible.

High Wycombe: (26 miles.) A slight dropping in strength was noticeable at this point and when passing through a tunnel the signals were entirely cut out, but owing to the speed of the train the gap was short. When passing under bridges fading was noticeable, but was insufficient to interfere with reception. In deep cuttings it was also noticeable, but in cuttings which did not rise appreciably above the aerial fading was almost non-existent. Passing through marshy and wet districts also seemed to cause a slight loss of strength. About three miles from Bicester quite a drop in signal strength was noticed, but no reason was apparent when looking at the surrounding country from the train. The strength was never less than that required to operate the loud speaker above the considerable noise of the train, except when passing through tunnels.

Bicester: (53 miles, 5.10 p.m.) The strength slightly increased and during the latter portion of the run to this point the train continually travelled at a speed of from 75 to 80 miles per hour.

Kings Sutton: (63 miles.) Although London was still received perfectly on the loud speaker it was decided to change over to Birmingham, which station (5IT, 475 m.) was easily tuned in on the telephones and came through at excellent strength.

Leamington: (23 miles from Birmingham.) A slight decrease in strength was noticeable as we ran into Leamington, but a considerable increase was at once apparent as we left the station, and onwards to Birmingham reception was at good loud-speaker strength on the five valves only. The tunnel on entering Birmingham station did not cut out the signals.

There was not at any portion of the journey any difficulty in receiving at good strength. A passing train, if travelling at high speed, caused a curious rushing sound in the loud speaker. When using earth A train noises were caused in the loud speaker, but when using earth B practically no outside noise was present; there was an entire absence of atmospherics, or fading due to atmospheric conditions.

On the return journey the van was shunted next to the engine of the 8 p.m. Paddington express in order to note whether the large body of metal formed by the engine would have any ill-effects upon the reception, and also whether the exhaust steam would cause any type of fading. This journey was made in the dark.

The Birmingham transmission was tuned in and the loud speaker worked until Leamington was reached, when a change over was made to the telephones in order that some of the more distant stations might be searched for. London was picked up at once at 8.55 p.m., approximately 80 miles away; Bournemouth (6BM, 385 m.) and Manchester (2ZY, 375 m.) were also picked up and the three stations were successfully transferred to the loud speaker, using all six valves. At 9.20 p.m., whilst somewhere in the Haddenham district, Aberdeen (2BD, 495 m.), 350 miles away, was tuned in on the telephones, but reception was weak. At 9.30 p.m. at Wycombe Cardiff (5WA, 353 m.) was strong on the loud speaker.

During the whole run a noticeable point was the entire absence of disturbing elements and the extreme ease with which reception took place; the tone modulator played a valuable part in clearing any "frying and spluttering" that might otherwise have been noticeable. It would appear that telephone reception is to be preferred to loud speaker reception on trains, as the former entirely cuts off the usual train noises. It would appear that almost any long-distance train should be in touch with at least two of the broadcasting stations pretty well throughout its journey. On the journey from London to Birmingham there are no blind spots on the route followed by the railway, and it should be remembered that the aerial was of an exceedingly poor description though ample for the purpose when used with a suitable receiver; the directional effects of such an aerial appear to be negligible. With regard to generator noises it should be noted that the van was gas-lighted, but that the next coach was electrically-lighted and, as the whole train is interconnected, the earthing arrangements do not appear to cause trouble through generator noises. The body of the engine appeared to have no appreciable effect on the results obtained and owing to the swaying of the empty van at speed vibration on the valves was intense. The most remarkable feature of the reception was its freedom from fading and atmospheric disturbance.

The experiment was made under what may be described as adverse conditions, and further trials, say in an ordinary coach, should be exceedingly interesting.

Hydro-Electric Plant for Manitoba.—In connection with a new ore-crushing plant, a company in Northern Manitoba is erecting a hydro-electric plant on the Grass River.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Looping-in.

Now that lead-covered twin and 3-core wiring is so largely installed, it is surprising that greater advantage is not taken of looping the wires in the ceiling roses and the switches.

The writer has noticed that where a switch feed passes through the light point it is often jointed by means of a porcelain connector inside the box. A cheaper and more satisfactory method would be to use a 3-plate ceiling rose, using the third terminal for looping the switch feed.

A similar case arises at the switch point, as often the light feed is taken to the switch and there jointed to one of the conductors in a twin cable, the other conductor, of course, being a switch wire. Such a joint is not satisfactory, and is not necessary if a switch is used having a third looping terminal such as is manufactured by Messrs. Crabtree.

The above two hints in practice tend to reduce cost, and undoubtedly improve the quality of the installation.

F. J. Pearce, A.M.I.E.E.

Sale, *April 8th*, 1924.

Plumbing Joints.

In your issue of February 15th last, Mr. B. Welbourn asks "why a plumber goes through the ceremonial of anointing a wipe with tallow." The use of tallow in this way formed the subject of careful investigation by the Engineering Department of the Post Office some time ago, and as a result the practice is now expressly forbidden, on the ground that the tallow prevents the detection of porous metal and of minute defects in the wipe when tested under air pressure.

It is quite a proper procedure before making a wipe to smear the surface of the lead with tallow, the function of which is to clean the surface chemically by means of the acid which it contains and enable the lead and solder to unite. On completion of the work, however, its use is unnecessary and harmful.

E. Turner.

Office of the Engineer-in-Chief,
G.P.O. (West), London.
April 10th, 1924.

Single-phase Induction Motors and the Starting Problem.

I have been following with interest the discussion on the above subject, the primary solution of which, according to the several participants in the correspondence, appears to lie either in the hand or the centrifugally-operated clutch—both admittedly efficient but comparatively expensive pieces of apparatus.

I submit that a more satisfactory solution not only of the above problem, but of most of the inherent defects connected with single-phase machines, is to be found in the recently perfected commutator type of motor with shunt characteristics as manufactured by the Electro-Dynamic Construction Co., Ltd.

This type of machine will not only start up against full load when taking 1¼ full-load current (and proportionately less current at lower loads) from the line, but will start against a heavy overload.

A feature of very considerable interest to the power station engineer is the power factor, which, on full load, is unity, and becomes leading as the load diminishes, a direct antithesis to the induction motor.

Another interesting point is the 50 per cent. speed control obtainable, while the commutation, and wear of commutator and brushes, are comparable with those of a d.c. machine.

E. J. Timberlake,
Director.
Electro-Dynamic Construction Co., Ltd.

London, *April 9th*, 1924.

Condenser-type Bushing Insulators.

In the article by Mr. G. L. E. Metz that you printed on November 30th last there are some practical hints that will doubtless prove useful to the inexperienced designer. At the same time, there are some theoretical errors that may lead him seriously astray; and as no one has yet drawn attention to these, I hope you will allow me to deal with them now.

In the fundamental formula—

$$G = V/(x \log R/r) \quad \ldots \quad \ldots \quad \ldots \quad (1),$$

the G is described by Mr. Metz as representing "the potential gradient at any point at a distance x from the conductor" (of radius r) in "a bushing insulator of the ordinary homogeneous character" (of external radius R). V is, of course, the voltage between the conductor and the earthed band; and the logarithms referred to here and elsewhere in this letter are to base e. But if x really did represent the distance from the conductor, the formula would tell us that an insulator of this

type must break down as soon as any voltage whatever is applied to it; for the potential gradient (which is a measure of the stress on the dielectric) would then be enormous at points near the conductor, where x would be practically zero. Actually, as will be seen from a study of the proof of this formula in books on electrostatics, the x represents the distance from the axis.

It follows that the greatest value of the potential gradient occurs where $x = r$, and the smallest value where $x = R$, so that the ratio of the greatest to the smallest is not "proportional to r/R" (as Mr. Metz describes it), but *equal* to R/r.

In the last column of his article, it is stated that the maximum dielectric stress is given by—

$$G = V/(r \log R/r) \quad \ldots \quad \ldots \quad \ldots \quad \text{(ii)},$$

and that we consequently have—

$$R/r = e^{/VGr} = e^{T/r} \quad \ldots \quad \ldots \quad \ldots \quad \text{(iii)},$$

"where $T = V/G$, the safe thickness of insulation to employ for the voltage V" when G is the safe stress. But formula (ii) only holds good when the bushing is of the homogeneous character first referred to, whereas the safe thickness will not be V/G in a bushing of this type, though it would evidently have that value if the bushing could somehow be made to have the same potential gradient throughout. From (iii) we have—

$$R = r(1 + V/Gr + V^2/G^2r^2\,!\, + V^3/G^3r^3\,!\, + \ldots)$$

$$\therefore R - r = V/G + V^2/G^2r2\,!\, + V^3/G^3r^2\,!\, + \ldots .$$

It will thus be seen that V/G is not the required thickness in cases where equation (ii) holds good: it is simply the limiting value to which this thickness tends as r tends to infinity. On the other hand, as will also be evident from the last equation, the required thickness tends to infinity as r tends to zero.

Newcastle-on-Tyne. **W. F. Dunton.**
April 10th, 1924.

Pyrometric Control.

I have been much interested by the paragraph on this subject in your issue of the 4th of this month, and think that, perhaps, a little further discussion might clear up some of the difficulties inherent in pyrometric measurements.

The parallel drawn between the pyrometer and the micrometer is quite true so far as it illustrates the necessity of using the pyrometer for temperature measurement in actual manufacturing operations; there is sometimes a similar parallel drawn between the pressure gauge on the boiler and the pyrometer on the furnace, and the argument again is equally strong but, as illustrating the relative difficulty of constructing pyrometric apparatus and making measurements therewith, as compared with the micrometer and the pressure gauge, it is important to recognise certain essential differences.

In the case of the micrometer the measurement is one of length, a quantity which is actually visible and tangible, while temperature, as such, can only be gauged by some secondary effect. Considering the pressure gauge, it is true, in this case, that pressure cannot be seen but must be measured by its effect upon something else, but there is the advantage that the pressure can be transferred from the boiler and measured at a distance—you do not have to put any part of the pressure gauge into the boiler. In the case of the pyrometer of the thermocouple type, which you say correctly is still the most widely employed, some part of the apparatus has to be put into the furnace and submitted to the destructive action therein, but, by the skill of the electrical engineer, the measurement of the effect of the temperature on this inserted part is transferred to a convenient distance.

One of the limiting conditions governing the design of the thermocouple pyrometer is the effect of the furnace temperature upon that part of the pyrometer which is subjected to that temperature; you are applying heat to effect some physical change in the product or the material in the furnace, boiler, &c., but you wish that this heat shall not have any effect of producing a physical change in the pyrometer which is subjected to the heat. It is only by careful study of the conditions in which each pyrometer will operate that the physical difficulties following from the considerations mentioned above can be overcome with satisfactory industrial results. Pending the discovery of the "ideal pyrometer" which we all wish for, but shall probably never see, the best results will be attained by clear recognition of the limitations in which the pyrometer operates. If the furnace conditions, including its temperature, are such that gradual destruction of the inserted part of the pyrometer is practically inevitable, then it is best to recognise this in the design of the instrument, and, if possible, to make that part subject to this destruction such that any error before actual destruction shall be negligible, that the destruction shall be relatively sudden, and that the replacement shall be simple and cheap. Given this set of conditions, then it should be recognised that the replacement of the destructible parts should be accepted as a routine matter comparable with firebrick linings and such other replacements. The actual cost of such replacements, with a pyrometer of suitable design, forms a negligible amount compared with the value of the product being treated and the possible savings due to improvement of the product and reduction of time and fuel consumption.

Pyrometer manufacturers nowadays do not make extravagant claims for their apparatus; they are always willing to advise the user on the limitations applicable to any particular type of pyrometer, and it will be generally agreed that the more the user knows about the instrument he employs the better the service he will obtain from it.

Chas. E. Foster, F.Inst.P.

Letchworth,
April 10th, 1924.

Bakers' Oven Hand-lamps.

In our own experience on the above subject, the difficulty has been confined entirely to the lamp.

We have tried various voltages and makes of both carbon and metal-filament lamps, but have not succeeded in finding anything to last more than a few days.

The best result obtained on a 220-V circuit was with a 250-V vacuum metal-filament lamp. The result, however, did not justify a continuance of the attempt, and the object was abandoned.

We should be glad to hear from anyone who has succeeded in finding a solution of this difficulty.

Teesdale & Jones.

Swindon, *April 12th*, 1924.

"What is Electricity?"

In the current issue of the Electrical Review (April 11th) there is an error in printing in the article entitled "What is Electricity?" by H. E. Yerbury, M.I.E.E. It commences in the 6th paragraph of the second column on page 589, where the matter is so involved that it is not at all clear what is meant.

I suggest that the line commencing "The thought, therefore, ——" is misplaced, as it occurs again a little lower down. By leaving this out, alone, however, the meaning is not made clear. Perhaps you will clear this matter up in your next issue?

Hampstead, *April 11th*, 1924. **Eric C. Peters.**

[We regret the error, introduced after the final proofs had left our hands. The sentence should read: "Were we able to demobilise the proton, the author submits that such action would constitute physical annihilation of such entity."—Eds. Elec. Rev.]

Is my friend Yerbury trying to pull our leg? A miracle ceases to be, the moment it is explained; and much the same happens to what we call "electricity," which some people buy by meter, but it should now be relegated to a suitable "limbo" along with caloric, phlogiston, energy, souls or spirits and other non-entities.

Effects are produced, and states arise or conditions are brought about by means termed "electrical"; but these are not evidence of the existence of electricity as substance!

With the demand for clear definition and precision in statement, made by several who took part in the discussion at Sheffield, I am in hearty accord; for clear thinking is impossible unless we have perfect agreement as to the meaning of terms employed; and I hope Mr. Yerbury's paper will set men thinking.

Wm. H. Massey.

Twyford, *April 13th*, 1924.

The Swiss Federal Railways.—According to the estimates prepared by the Swiss Federal Railway Administration for 1923, the operation of the railways was expected to result in a deficit of 25,000,000 fr., but as a result of increased receipts and a reduction in expenses last year closed with a surplus of about 3,000,000 fr. Encouraged by these results the Swiss Federation recently offered for subscription a further loan in order to provide funds for proceeding with the work of electrification. The rapid sequence of such loans has raised the question as to the economic justification for the large expenditure involved in the great scheme of conversion to electric traction. On this point it is known that after the work of conversion of a total length of 970 miles of line proposed to be electrified is completed, the total consumption of coal will be 450,000 tons less per annum than when steam locomotion was in operation, on the basis of the traffic obtaining in 1913. At the price of 60 fr. per ton of coal this represents a sum of 27,000,000 fr. per annum, which will no longer have to be paid to other countries for deliveries of coal. It is also of importance to note that most of the expenditure on the work of conversion is incurred in Switzerland. The more the traffic increases the more economical electrical working will be, to say nothing of the other advantages of higher speed and the greater power of the electric locomotives which permit the haulage of heavier trains.

Reviews.

Modern Mechanical Engineering. A practical treatise written by specialists. Edited by A. H. Gibson, D.Sc., M.Inst.C.E., M.I.Mech.E., and Alan E. L. Chorlton, C.B.E., M.I.Mech.E., M.I.E.E. In six volumes, each about 250 pages, with numerous illustrations and drawings. London: The Gresham Publishing Co., Ltd., 66, Chandos Street, Covent Garden, W.C. Price 4 guineas net.

Electrical engineering has been described as a branch of mechanical engineering, and certainly in so far as the electrical engineer is concerned with the actual generation of electrical energy by the use of some form of heat engine or other type of prime mover this is correct, since the harnessing of natural power and its conversion into other and more usable forms is the task of the mechanical engineer. Again, in the design and production of electrical plant, such as alternators, motors, &c., similar processes are used in the foundry and in the machine shop as are used in the production of the engines themselves, and therefore in this direction, too, electrical engineering and mechanical engineering are akin. There are, of course, a number of branches of mechanical engineering which are only of academic interest to the electrical engineer, just as there are very many phases of electrical engineering which are in no way connected with mechanical engineering. Sufficient has, however, been said to indicate that a large work of six volumes dealing with all phases of the vast subject of mechanical engineering should contain much that is of interest and value to the electrical engineer.

A brief study of the contents of the various volumes of the work under review will indicate the extent to which this is true in the present case. It may be mentioned at the outset that the various subjects have been dealt with both in their theoretical and practical aspects by different writers, who are in nearly every case men well known as being particularly qualified to deal with a particular branch of engineering, and while this makes for a certain lack of unity of treatment and not a little duplication and overlapping, it means that the reader is getting the views of a recognised expert in each section of the subject. Volume I deals appropriately enough with the drawing office, with which is incorporated the estimating and the costing office. The problems of organisation are considered, and attention is drawn to the methods of estimating and costing, particular stress being laid on the necessity for keeping full records of weights and costs of all jobs with a view to the accurate estimation of similar work in the future. Pattern making is next dealt with in a sufficiently comprehensive manner, although in view of the importance of electrical machinery we should have liked to see a description of the method of making typical patterns for this class of job. The same applies to the section on foundry work. The actual examples of patterns and castings taken in each of these sections are, however, well chosen, and would certainly indicate the methods to be adopted in the manufacture of electrical machinery. This volume concludes with a section on the machine shop, in which the various tools usually employed are described, and a chapter is given on the erection of heavy machinery, including notes on the erection of a 20,000-kW turbo alternator. It is a pity that the necessity for making the volumes all more or less equal in size, compelled the continuation of the subject of the manufacture of machinery in Volume II, as we find the earlier chapters of that volume dealing with the transport of heavy machinery which should obviously have been included in Volume I. This is followed by a brief section on pipe work, with particular reference to steam pipes, after which we have a number of sections on applied mechanics and the strength and elasticity of materials. These have been well done, and it is a commendable feature of this part of the theory that the more elementary and generally known parts of the subject are hurriedly passed over and the lesser known parts dealt with at greater length. Of particular value in this volume is the section on the testing materials. Not only have we the usual tensile and compressive tests described, but bending, torsion and, what is probably of even greater importance, fatigue and hardness tests are also dealt with in a very comprehensive manner.

The third volume contains first of all a section on hydraulics in which the problems of flow in pipes and open channels are studied, and a valuable, albeit somewhat brief, study is made of the question of guaging streams. This section is of particular interest to the hydro-electric engineer, and we should have liked to have seen the subject of catchment areas, dams and kindred problems included. The problem of the water turbine is dealt with at a later stage in this volume, after a number of chapters dealing with pumps—both reciprocating and rotary—fans, air compressors, and hydraulic machinery of the usual pressure type, such as presses, cranes, &c. The section on water turbines is very well done, and contains a number of working drawings of actual installations. The volume concludes with a section on refrigeration. The opening sections of the fourth volume deal in conventional manner with mechanisms and machine drawing and design, after which we turn to the section on applied heat. Here the difference of authorship is at once apparent, for whereas in previous sections, as we have already noted, the more elementary parts of the subject are quickly passed over, here we have a very detailed treatment of elementary heat more from the point of view of the young student of physics than of the engineer. This is followed by chapters on thermodynamics and heat engine cycles, which are very well done. Included in this volume are three valuable entropy charts for ammonia (NH_3), carbon di-oxide (CO_2), sulphur di-oxide (SO_2), and it is to be regretted that the section on refrigeration was not brought into this volume so as to be with these charts and the text on reversed heat engines. The volume concludes with a number of chapters on boilers—fire tube and water tube—mechanical stoking, feed water heating and oil firing.

In the fifth volume the subject of the generation of steam is continued, and we have a chapter on coal and ash handling plant. This is followed by a valuable section on engineering chemistry, which is very well done. In addition to dealing with fuels; flue gases, feed water and lubricants are also studied in detail, methods of treatment as well as of testing being included. We then come to the steam engine. The reciprocator is first of all dealt with, after which we have a number of chapters on the steam turbine, including one on special types of turbine such as the mixed pressure turbine and the bleeder turbine. This is a section of great value to electrical engineers. We note here that a folding plate, giving the sectional drawings of a 6,000-kW turbo-alternator is included, this being identical with the plate incorporated in Volume II. The volume concludes with chapters on condensing plant, including air pumps, ejectors, and cooling towers, followed by a few brief notes on the operation of land power plant. The sixth and last volume may be said to deal with the internal combustion engine and its accessories. Perhaps too much attention has been given to the motor-car engine and the aero engine, and not enough to the stationary gas or heavy oil engine, but the various sections dealing with the latter types are, on the whole, very well done, although the different treatment of the gas and the oil engine, due to different authorship, is very noticeable. The drawings of a six-cylinder Mirrlees Diesel engine of 750 b.h.p. are a feature of the volume.

In conclusion, it is of interest to speculate as to the desirability, or even the possibility, in these days of specialisation, of studying every branch of the vast subject of mechanical engineering. For example, the engineer in charge of the power-station has little or no time to study foundry methods, nor indeed is it of any practical value to him, and thus the wisdom of covering so vast a field in the compass of a single work is open to question; but to the student and to the young engineer who has not yet decided to devote himself to any definite branch of his profession and who should be therefore desirous of increasing his general knowledge of engineering, a work such as this should be of considerable value; while as a work of reference, particularly in view of the very complete index which is included at the end of the last volume, and which from a rough estimate we find contains about 2,000 entries, it should prove particularly useful.

The Control of the Speed and Power Factor of Induction Motors. By Miles Walker, M.A., D.Sc. Pp. 151; figs. 125. London: Ernest Benn, Ltd. Price, 18s. 6d. net.

The publication of a treatise by Prof. Miles Walker is generally considered by electrical engineers and designers as an important event in the history of electrical progress, and his latest book is worthy of being so regarded. In few other branches of heavy electrical engineering has progress been so rapid as in the production of apparatus for improving the power factor and of devices for obtaining an economical range of speed of induction motors. This is largely due to the recognition of the fact that the extension of the supply of energy over much larger areas will be carried out by the three-phase system for the distribution network as well as for the main transmission scheme. But the ordinary induction motor is essentially a constant-speed machine with a lagging power factor, and these two characteristics have hitherto limited its usefulness in many directions. Recent advances, however, have made it possible for these disadvantages to be eliminated, and induction motors having a wide range of economical speeds and operating at unity power factor or even taking a leading current are now available for the power user.

In Prof. Walker's book, the theoretical and practical aspects of this problem are very ably dealt with. The method of treatment of induction motor theory is by the principle of inversion, and two chapters are devoted to an exposition of this theory and its extended application to the circle diagram for the solution of the more complex induction motor problems. The several methods of speed and power factor control are treated fully and their relative advantages compared. It is to be observed that when a range of speed is required comparable to that obtainable with the direct-current motor, a commutator forms an indispensable adjunct. Up-to-date information is given on the subjects of pole changing and cascade connections with the modifications embodied in the Hunt and Creedy motors. An admirably clear explanation is given in connection with the former type of motor. The Krämer method of using a synchronous converter in the rotor circuit, the Kapp vibrator and the Leblanc exciter, &c., are dealt

with, while the connection diagrams and performance curves throughout the book are of great interest and importance. The author gives an account of the conditions to be met with in the design of motors for the electrical propulsion of ships. The performance of the Boucherot motor, in which resistance and reactance are provided in two rotor circuits connected in parallel, is determined by a circle diagram based on the principle of inversion, and its application to the problem of electrical ship propulsion exemplified. All engineers should make themselves acquainted with these developments in induction motor practice and no better guide could be found than Prof. Walker. The letterpress, illustrations, and diagrams in the text are excellently produced.

Principles and Practice of Telephony. By JAY G. MITCHELL, M.A.I.E.E. Vols. 4 and 5. London: McGraw-Hill Publishing Co., Ltd. Price, 12s. 6d. each volume.

These two volumes form the continuation and completion of those which were recently reviewed in these columns. In Volume 4, the author deals with inter-office trunks, manual equipment, call distribution, two-digit mechanical, and trunk mechanical switching; and closes with a discussion of mechanical switching traffic. A series of curves are given showing the probable maximum number of calls for average rush-hour calling rates for various sizes of groups. Volume 5 deals with combinations, including switches, the principles of semi-mechanical switching, semi-mechanical equipment—the last mentioned being sub-divided into chapters on the relay finder, switch selectors, and collateral operations—and a final chapter on extra heavy traffic capacity switching equipment.

The remarks made in reviewing the earlier volumes of this work apply equally to the two later ones. The explanatory matter is clear and concise, and is written in a manner that will appeal to the reader who is desirous of obtaining a real working knowledge of modern telephony. The diagrams again suffer from contraction in reproduction, but the author, anticipating difficulties in this respect, has in Volume 4 considerately supplied enlarged copies at the end of the volume. As in the earlier volumes, each chapter is followed by a series of review questions by which the reader may test the extent to which he has assimilated the matter dealt with throughout the chapter.

Business Notes.

Our Next Issue.—Owing to the Easter Holidays, the next issue of the ELECTRICAL REVIEW (April 25th), will be published one day later than usual—that is, on Friday evening instead of Thursday evening.

Bankruptcy Proceedings.—GEORGE FREDERICK NEAL, 5, Smallgate, Beccles, Suffolk, electrical engineer.—The first meeting of creditors was held on April 9th at the offices of the Official Receiver, 8, Upper King Street, Norwich. The statement of affairs filed shows liabilities of £510, while the assets amounted to £46, from which had to be deducted £30 for preferential claims, leaving net assets of £16, or a deficiency of £493. The debtor entered into partnership with another in March, 1920, trading at the above address. Since 1921 he has carried on the business alone. In March, 1920, he had a capital of about £50. He has been aware of his position for the past twelve months. The case being a summary one was left in the hands of the Official Receiver as trustee of the estate. The public examination was held recently at Great Yarmouth, when debtor stated that during the war he was an assistant inspector under the Air Ministry and in 1918 went to Norwich as a chief inspector in an engineering works. With regard to the partnership he said that there was no formal dissolution, but he had paid all the firm's debts. He traded as the G.F.N. Engineering Co. from October, 1921, on his own account. The present position was attributed to insufficient trade. The examination was closed. The following are creditors:—

	£		£
J. A. Bailey	20	London Factors & Agents, Ltd. ...	18
Calmont, King & Co.	21	R. Ife	30
Ellis (Gray & Palmer)	18	T. P. Neal	120
East Anglian Electricity, Ltd. ...	31	Radio Instruments Co.	27
Hackbridge Cable Co.	15	Bankers	22
Lee, Albert & Co.	29	A. J. Dew & Co.	66

HARRY ROGERS, 11, Grosvenor Street, Chester, formerly an electrical engineer at Friarsgate, Warrington.—According to the *Warrington Examiner*, this bankrupt appeared recently for his public examination. He estimated his unsecured liabilities at £3,411, with net assets at £1,426. In reply to the Registrar, the Deputy Official Receiver, Mr. D. Heliar, said that the debtor had not submitted a statement as required to show amongst other things how an alleged loss of £2,120 in a year was arrived at. Mr. R. H. Gasquoine, of Chester, submitted that Mr. Rogers had disclosed all he possibly could. Registrar T. J. Ridgway said that the bankrupt had not impressed him at all in the examination that he had done all he could either to help the Official Receiver or the trustee, or to make a full and proper disclosure of all his transactions and assets. There was only one course to adopt, and that was to adjourn the examination *sine die*.

C. K. WALLIS, electrical engineer, 51, Mons Avenue, Bognor.—Receiving order made April 9th on debtor's own petition.

T. SCOTT (separate estate), trading in partnership with J. CAMPBELL as T. Scott & Co., wholesale electrical suppliers, 42, Handyside's Arcade, Newcastle-on-Tyne.—Discharge granted subject to bankrupt's consent to judgment for £25 being entered against him and 30s. costs.

A. H. MILNES, electrical engineer, 48, Lidget Street, Lindley, Huddersfield.—Last day for proofs for dividend, April 25th. Trustee, Mr. W. Durrance, Official Receiver, 12, Duke Street, Bradford.

ASSOCIATED ELECTRIC CO., electrical factors, 21, Waterloo Street, Glasgow, and PATRICK MARK HEALY as sole partner.—A meeting of creditors was called for April 17th at the Faculty Hall, St. George's Place, Glasgow. Mr. H. T. Waddell, agent, 113, St. Vincent Street, Glasgow.

Company Liquidations.—AUCKLANDS WIRELESS, LTD., 395, St. John Street, and 125-131, Rosebery Avenue, London, E.C.1.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was held on April 7th, at the Manchester Hotel, Aldersgate Street, London, E.C., when the chair was occupied by Mr. F. G. Jenkins, A.C.A., 5, Philpot Lane, E.C., who stated that he had been appointed to act as the liquidator in the voluntary liquidation of the company. A statement of affairs was presented, which disclosed liabilities of £3,444, made up as follows: Trade creditors, £3,053; loan creditor, £150; and bankers, £240. The assets comprised: Lease of factory at Rosebery Avenue, plant, machinery, and small tools, fixtures and fittings, and stock-in-trade, £4,511, estimated to produce £3,500; stock-in-trade at St. John Street, £881, expected to realise £250; fittings, valued at £25; cash register, £75; book debts estimated to produce £500; investments, £50; and motor van, £33; making total assets of £4,433, from which had to be deducted £444 for preferential and secured claims, leaving net assets, subject to the costs of liquidation, £3,989. The statement, therefore, showed a surplus as regarded the unsecured creditors of £545. It was reported that the company was registered on June 11th, 1923, with a nominal capital of £7,000, of which £5,250 ordinary shares of £1 each were issued as fully paid. The company was formed to take over the business of G. Z. Auckland. The consideration was the allotment of 5,000 ordinary shares of £1 each, fully paid. It appeared that the company acquired assets valued at £8,798, against liabilities of only £3,330. A trading account prepared by the company for the period from April 1st to December 31st of last year showed a net loss of £3,879, or an average weekly loss of £100. The probability was that during the company's existence there had been a loss on the trading of £5,000. In answer to a question the liquidator stated that an offer of £3,500 had been received for the purchase of the assets. After a short discussion it was decided to confirm the voluntary liquidation of the company, with Mr. F. G. Jenkins as liquidator, while an advisory committee of three of the principal creditors was also appointed. The following are creditors:—

	£		£
Adelphi Press	36	Income Tax Sch. "D"	32
British Thomson-Houston Co., Ltd.	48	King & Wilby	115
Britannia Rubber & Kamptulicon Co., Ltd.	47	Millet, J.	17
Brown, S. G., Ltd.	30	Mutton, A.	150
British Broadcasting Co., Ltd. ...	207	Muhlenkamp	110
Brilliant Wireless, Ltd.	30	McMichael, L., Ltd.	38
Cossor, A. C., Ltd.	155	Mullard Radio Valve Co., Ltd....	94
Churchill, C., & Co., Ltd. ...	71	Morris, W. R.	14
County of London Electric Supply Co., Ltd.	45	Matthew Drew & Co.	16
Dubilier Condenser Co., Ltd. ...	17	Marshall, Percival & Co.	17
Day, B., Ltd.	33	Morris, P. D.	60
Day, B., Ltd.	16	*Model Engineer*	17
Edison Swan Electric Co., Ltd.	58	Marconi's Wireless Telegraph Co. Ltd.	23
Ever-Ready Co., Ltd.	86	Metropolitan Borough of Finsbury	28
Benn Bros., Ltd.	81	Bankers	240
Falk, Stadelmann & Co., Ltd....	168	Peronet, Ltd.	25
Ford & Son	91	Radio Instruments, Ltd.	23
Federation of British Industries...	27	Radio Press of Canada	40
Graham & Co., Ltd., Alfred ...	43	Sterling Telephone Co., Ltd. ...	83
General Electric Co., Ltd. ...	53	Siemens Bros. & Co., Ltd. ...	235
Gas Light & Coke Co., Ltd. ...	27	Scott Insulated Wire Co., Ltd....	145
Horological Journal	36	Stuart Adams & Co.	34
Herve, L., Ltd.	27	Telegraph Condenser Co., Ltd....	144
Hart Accumulator Co., Ltd. ...	16	Trader Publishing Co., Ltd. ...	28
Igranic Electric Co., Ltd. ...	117	Thomas W. Ivanhoe	100
		Varley Magnet Co., Ltd.	54
		Wenborn	15

CHARLES LEONARD LOTE, 8, Bray Street, Willenhall, Staffs., plumber and electrician.—The public examination of this debtor was held recently at Wolverhampton. Debtor attributed his failure to loss on contracts, shortage of money, and bad trade. He commenced business in February, 1919, with £50 capital, and traded at Gipsy Lane and 19, Summer Street, Willenhall. He discontinued trading about December, 1922, and had been unemployed ever since. Creditors sued him, and an execution was levied. The examination was adjourned to be closed.

Dissolutions of Partnership.—SCHUIL & CULLINAN & Co., electrical engineers, Old Drill Hall, Hebburn.—Mr. J. Schuil and Mr. R. Cullinan have dissolved partnership. Debts will be attended to by Mr. Schuil, who will continue the business under the style of J. Schuil Engineering Co.

FOREST CITY ELECTRIC SERVICES SUPPLY Co., electrical engineers and electricians and dealers in electrical supplies, 10, Princess Street, Chester Road, Manchester.—Mr. A. T. Craston and Mr. S. T. Quilliam have dissolved partnership. Mr. Quilliam will attend to debts and continue the business.

Private Arrangement.—VOSPER & VOSPER, electrical engineers, 19, Thomas Street, Armagh, Ireland.—A meeting of the creditors of the above was held on April 7th, when it was reported that the liabilities amounted to approximately £1,900 and the assets to about £514. An offer of 4s. in the £, in cash, was made, but the creditors decided that the meeting should be adjourned in order that an investigation might take place. The following are creditors:—

	£		£
Edwards & Edwards	42	Marconi's Wireless Telegraph Co., Ltd.	24
Dempsters Typewriter Co., Ltd.	17	Davisdon, R., & Co., Ltd. ...	15
Drake & Gorham, Ltd.	744	Thomas Brooks & Co.	20
Chloride Electrical Storage Co., Ltd.	194	Corry & Co., Ltd., J. P.	15
Gardners Engines, Ltd.	271	Auto Bulbs, Ltd.	18
Stuart Turner, Ltd.	42	Electric Installation & Repairing Co.	166
Simpson, Baker & Co., Ltd. ...	48		
Johnson & Phillips, Ltd.	23		

Meeting of Creditors.—GWYNNES ENGINEERING Co., LTD.—The meeting of the creditors of the company called on April 9th unanimously approved the scheme of arrangement outlined in our last issue (p. 578). The chairman pointed out that the scheme was only a temporary one, and would stand until the main scheme of reconstruction was submitted, which would be as soon as possible. That scheme would involve the formation of two subsidiaries, the parent company being a holding concern.

Trade Announcements.—MESSRS. REGINALD WOOD & Co., of Byram Arcade, Huddersfield, are opening a showroom at 37, Westgate, Huddersfield, for electrical contracting and wireless supplies. They desire to receive manufacturers' catalogues.

MESSRS. THORN & HODDLE, LTD., of 151, Victoria Street, London, S.W.1, have added an electrical contracting department to their business. They desire to receive catalogues, &c., of electric lighting fittings and accessories, batteries, motors, and various other manufactures.

With reference to the announcement made here last week regarding the formation of a new Manchester company, we learn that the title of the company is: NORTHERN DISTRIBUTORS, LTD. (16, Princes Chambers, John Dalton Street, Manchester). We are asked to state, however, that it will confine its activities to the distribution of Messrs. Peto & Radford's portable batteries and will not handle the stationary batteries manufactured by Messrs. Pritchetts & Gold and E.P.S. Co., Ltd.

SIR ISAAC PITMAN & SONS, LTD., notify us that their telephone number has been changed to "Gerrard 3538" (two lines).

MESSRS. MIDDLETON & MUNRO, electrical contractors, of 59½, Clyde Place, Glasgow, announce that they are giving up business.

MESSRS. BARNETT & SOANS, electrical contractors, &c., of Kettering, are opening a branch at Abbey Street, Market Harborough, and they desire to receive catalogues and lists.

Catalogues and Lists.—CHLORIDE ELECTRICAL STORAGE Co., LTD., Clifton Junction, Manchester.—Exide battery service technical letter No. 4 for motor car dealers, giving instructions regarding leaky battery boxes. We have also received a card (Form 1010), which embodies a series of useful hints for the owners of electric vehicles. The battery information applies to Ironclad-Exide batteries, but the hints given apply generally to other types of batteries. The card will be sent free to electric vehicle users on application to the Chloride Co.

AUTOMATIC & ELECTRIC FURNACES, LTD., 173-175, Farringdon Road, E.C.1.—Heat Treatment Bulletin, No. 32, "Carburisation," by J. W. Urquhart, dealing with the elementals of the process, depth of penetration, regeneration of the core, and surface-hardening quenching.

MESSRS. JAMES MCMILLAN & Co., Clun House, 17, Surrey Street, W.C. (Agents for Jägers Elektriska Aktiebolag, Sweden.)—A pamphlet dealing with immersion heaters, priced in Swedish kroner.

MESSRS. SUTCLIFFE BROS. & BRYCE, LTD., Globe Works, Hyde.—An illustrated leaflet advertising boiler front covers.

ECONOMIC ELECTRIC, LTD., 10, Fitzroy Square, W.1.—A priced and illustrated catalogue of radio-telephone apparatus.

MESSRS. JAMES GORDON & Co., LTD., Windsor House, Kingsway, W.C.2.—An illustrated descriptive pamphlet dealing with the "Copes" system of feed-water regulation.

MESSRS. DONOVAN & Co., 47, Cornwall Street, Birmingham.—An illustrated price list of electrical supplies of all kinds, including wiring materials, accessories, switch- and fuse-gear, &c.

ELECTRICAL DEVICES, LTD., 18-20, Collingwood Street, Newcastle-on-Tyne.—A price list of radio receiving sets and accessories, and a catalogue of "Universal" domestic appliances, "Miller" lighting fittings, &c.

CENTRIFUGAL CLUTCHES, LTD., 32, John William Street, Huddersfield.—A leaflet illustrating the "Lydall" clutch and its application to an electric motor.

MESSRS. JOHN CLARK & SON, LTD., Railway Arches, Blackfriars Road, S.E.1.—A number of pamphlets advertising plate glass, mirrors, &c.

MESSRS. JOHN MARKS, LTD., 54, Newcomen Street, S.E.1.—A series of pamphlets and samples relating to tracing and printing papers and linens.

Prices of Raw Materials.—MESSRS. LINDSAY & WILLIAMS, LTD., of Bennett Street Works, Ardwick, Manchester, have issued a useful chart showing the changes in prices of raw materials for electric cable manufacture throughout the year 1923. It is in the form of a stout hanging showcard covered in washable gelatine.

The Engineering Industry and the Safeguarding of Industries Act.—The following is a copy of a resolution unanimously adopted by the Council of the British Engineers' Association at a meeting held on April 10th:—"The Council of the British Engineers' Association view with grave concern the decision of H.M. Government not to introduce legislation to extend the duration of the provisions of Part II of the Safeguarding of Industries Act which deal with the making of Orders on the ground of depreciation of foreign currency. Their concern is not limited to the decision itself, but extends to its implications as indicating the attitude of the Government towards the manufacturing industries of the country in their present struggle with adversity at a time when the most urgent need is to provide increased wealth-productive employment for our people."

For Sale.—Messrs. Fuller, Horsey, Sons & Cassell will include in their sale, at the Baltic Exchange, on May 1st, two Metropolitan-Vickers 80-kVA, 3-phase alternators with switchgear, &c. (See our advertisement pages to-day.)

Book Notices.—"The *Transactions* of the South African Institute of Electrical Engineers." February, 1924. Johannesburg: The Institute. Price 2s.—This issue contains Mr. B. Sankey's presidential address dealing with the progress of central station engineering, as well as reports of other proceedings.

"The Year-Book of Wireless and Telegraphy and Telephony, 1924." Pp. lxiv; illustrated. London: Wireless Press, Ltd. Price, 15s. net.—The new issue of this well-known work has been relieved of the list of "ship stations" and other matter available elsewhere, whilst the list of "land stations" and wave lengths has been brought up-to-date. The maps, regulations, codes, &c., have been revised in accordance with the latest information, and special articles have been contributed on "Atmospherics," by Dr. E. V. Appleton; "Dull Emitter Valves," by Capt. C. F. Trippe; the "Ideal Empire Wireless Chain," by Mr. Robert Donald; "Progress in W.T. in the British Mercantile Marine during 1923," by Commander J. A. Slee, C.B.E.; and "Polar Diagrams of Reception," by Mr. R. Keen. "Direction-finding" is again dealt with by Dr. R. L. Smith-Rose, and "Aviation" by Mr. D. Sinclair. The Year-Book will be found invaluable as a work of reference by all who are interested in wireless communication in its professional and commercial aspects.

"Publications of the U.S. Bureau of Standards." Circular No. 151, "Wall Plaster: Its Ingredients, Preparation, and Properties" (15 cents); and Scientific Paper No. 480, "A Directive Type of Radio Beacon and its Application to Navigation" (5 cents). Washington: Government Printing Office.

"Memoirs of the College of Science," Kyoto Imperial University. Vol. VII, No. 2. (61 pp.). Kyoto: Maruzen Co., Ltd. Price, 1 yen.—The papers printed in this issue include one on "The Contact Potential," and a number of chemical studies.

The Edison Swan Electrical Co., Ltd., has published a booklet entitled "The Origin of Period Decoration." This illustrates the evolution of decoration in architecture and furniture, and the application of "period" styles to lighting fittings.

"The Post Office Electrical Engineers' *Journal*." Vol. 17. Part 1. April, 1924. London: ELECTRICAL REVIEW, Ltd. Price 2s. net.

We have received a copy of the Johannesburg *Star* of March 11th, 1924, together with the annual commercial and financial supplement. Copies can be obtained from the Argus South African Newspapers, Ltd., 82-85, Fleet Street, E.C.

Edinburgh Rejoins the N.J.B.—On the recommendation of the Electricity Committee the Corporation is to rejoin the National Joint Board for the Electricity Supply Industry.

British Empire Exhibition Notes.—OPENING.—The ceremonial opening of the Exhibition is to take place, as previously announced, on Wednesday next. His Majesty the King, accompanied by the Queen, will be met at the North entrance by the Prince of Wales, as President of the Exhibition. The ceremony will take place at 10.30 a.m., and the King's speech will be broadcast by the B.B.C.

SPECIAL STAMPS.—The King has approved a design to appear on special postage stamps which will be issued during the period of the Exhibition.

Census of Production.—The President of the Board of Trade has appointed the following gentlemen, together with officials of the Home Office and the Board of Trade, to be a committee for the purpose of advising the Board as to the preparation of the forms and instructions necessary for the taking of the third Census of Production, and the making of any rules under the Act:—Mr. T. J. Arnold, J.P.; Sir Arthur Balfour, K.B.E.; Sir Hugh Bell, Bart., C.B.; Professor A. L. Bowley; Mr. Stephen Easten, O.B.E.; Sir Henry J. Gibson, K.C.B.; Mr. Kenneth Lee; Professor D. H. MacGregor; Mr. R. C. Perry, C.B.E.; Sir W. Peter Rylands; and Mr. Arthur Shaw. The secretary of the committee is Mr. G. A. G. Stanley, Board of Trade, Great George Street, S.W.1, to whom all communications should be addressed.

The Committee held its first meeting last week and has already dealt with a number of preliminary questions. Among these is the method of framing the voluntary part of the returns to ensure a satisfactory response. In this connection the views of Chambers of Commerce and trade associations are to be sought. It is pointed out that every precaution is taken that no information given shall be disclosed; heavy penalties are provided for breach of secrecy by officials or others. The forms will be simple and arranged so that any firm with properly-kept books will be able to provide the information asked for with a minimum of trouble. For the convenience of those firms whose financial year does not close on December 31st, 1924, it is being provided that the figures for the year ending nearest that date will be accepted.

Proposed Engineering Conference.—During last week the Engineering Employers' Federation sent an invitation to all the trade unions of which employés in the engineering industry are members to a conference to discuss methods of avoiding disputes in the industry. There are seventeen of these unions, among them being the Amalgamated Engineering Union, the Electrical Trades Union, the National Union of General Workers, the Federation of Engineering and Shipbuilding Trades, the Boilermakers' and Iron and Steel Shipbuilders' Society, and a number of organisations representing metal and textile workers, &c. The formation of a joint committee is suggested "to consider how the present unsettling conditions in the districts may be avoided and the stability of the industry as far as possible secured."

German Import Duty on Aluminium.—The German Free Trade Federation has come forward with a protest against the Government proposal to place an import duty on aluminium to the extent of 10 per cent. of the value. It is pointed out in opposition to the scheme that aluminium is produced in Germany exclusively at works owned by the Reich, and that, in contradistinction to the use of water power in other countries, the German works are dependent upon the consumption of lignite for the generation of steam power for the works turning out aluminium, so that the costs of production are larger than in Switzerland, France, Italy, German-Austria, Norway, and North America. It is further stated that the price of aluminium is maintained by the International Aluminium Syndicate at the very high level of 280 Swiss fr. per 100 kg., or 205 gold marks. If the State aluminium works could not earn profits at this price, which is more than double that in pre-war times, it is held to be worthy of consideration as to whether these works can continue in existence in the long run, for the few hundreds of workmen employed in the latter play an insignificant part as compared with the number engaged in the aluminium consuming industries. Raw materials such as silver, copper, lead, zinc, nickel, antimony, chromium, &c., are exempt from import duties, and if a duty is now imposed upon aluminium, the Federation states that this will have the effect of strengthening the disposition in other countries to follow the example.

New French Company.—A new company has lately been formed in Paris (56, Rue du Faubourg St. Honoré) with a capital of three million fr., and the title La Compagnie Lorraine de Lampes Electriques.

Lead.—In their report dated April 12th, Messrs. James Forster & Co. state:—"There was a continuous drop in prices throughout the week, except on Tuesday, when April lead rose 2s. 6d. This was due to some buying by electrical cable manufacturers on the placing of a Post Office order, but when this buying ceased prices rapidly fell away through lack of support. A big selling order in the market on Thursday was said to be Mexican lead. . . . The Board of Trade returns are as follows:—Imports, 16,117 tons; exports, 1,103 tons; leaving for home consumption 15,014 tons. Of these imports 7,463 tons came from Australia, and only 700 from Mexico."

The Easter Holidays.—The London Electric Firm, of Croydon, will reopen its works on the morning of Wednesday, April 23rd, after the holidays.

Catalogues Wanted in South Africa.—Catalogues of electrical and wireless goods are asked for by Mr. J. Hodges, electrical engineer and contractor, 112, Main Street, Port Elizabeth.

Machine Tool and Engineering Exhibition.—We have received from the Machine Tool Trades Association a preliminary list of exhibitors at this exhibition, which is to be held at Olympia from September 5th to 27th. Among the names we observe those of several electrical and allied firms.

International Radio Exhibition.—The first annual International Radio Show will be held at New York from September 22nd to September 28th. The exhibition will be under the auspices of the newly-organised Radio Manufacturers' Show Association, which is composed of 60 of the most prominent radio equipment manufacturers. Over 70 per cent. of the available space has already been taken, according to Mr. James F. Kear, the manager of the show, whose address is: The Prince George Hotel, 14, East 28th Street, New York City.—*Reuter's Trade Service* (New York).

Social Events.—The directors of Hightensite and Ebonite Manufacturing Co., Ltd., entertained the manager and staff at a dinner at Pagani's Restaurant on April 9th. Mr. Charles Comins, J.P., F.C.A., proposed "Success to the Company," which was responded to by the chairman, Sir Leonard Powell, J.P., and the manager, Mr. W. H. J. Downton. Mr. Gerald Powell proposed the toast of the staff, to which Mr. Batterham, the secretary, replied for the London office and Mr. Ivy for the staff at the factory.

The staff of the Metropolitan-Vickers Electrical Co., Ltd., held their carnival and cabaret on Friday last; the attendance numbered about 2,000. A number of clever cabaret entertainments were interspersed between the dances, the last of all being a mock bull fight in which the "bull," after being chased by "picadors" on hobby horses, and "banderillos" with feather darts was despatched by the "matador" with a number of strange weapons. After this the rest of the dance programme, which was supplied throughout by the Garner-Schofield Orchestra, was broadcast from 2ZY by courtesy of the B.B.C. and Mr. Dan Godfrey, junior, the director of that station.

The Association of British Exhibitors.—The Association of British Exhibitors has prepared for this year a forceful programme for the purpose of safeguarding and advancing the interests of all exhibitors and stall-holders at exhibitions throughout the kingdom. In order to make its influence as complete and effective as possible, the Association has organised a separate intelligence bureau so as to keep its Executive Council and also its members in constant contact with the conditions existing at exhibitions and above all with exhibitions about to be promoted. Every possible field is explored for the purpose of collecting data, and the Bureau will be a powerful instrument in assisting members.

British Trade Mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month from the dates mentioned:—

Ozonox. No. 440,796. All goods in Class 6, but not including dynamo-electric machines, electric current alternators, converters, and transformers, &c.—Martin Kristensen Trairup, 4, Jasper Road, London, S.E.19. April 9th, 1924.

Combinator. No. 443,472. Class 6.—Machines for obtaining intermittent uni-directional currents of electricity from alternating currents. Uni-Directional Apparatus Co., Ltd., 14 and 16, Cockspur Street, London, S.W.1. April 9th, 1924.

Pegasus (lettering and design). No. 436,581. Class 8.—Apparatus for use in wireless telegraphy and telephony. William J. Clark and Arthur T. Roberts, "Rosebarn," Buck's Avenue, Oxley, Herts. April 9th, 1924.

General Radio (lettering and design). No. 443,755. Class 8.—Instruments and apparatus for use in wireless signalling. General Radio Co., Ltd., Twyford Abbey Works, Acton Lane, Harlesden, N.W.10. April 9th, 1924.

Duanode. No. 442,585. Class 8.—Electrical condensers for use in wireless telegraphy and telephony. Fallon Condenser Manufacturing Co., Ltd., 230a, Hermitage Road, London, N.4. April 9th, 1924.

Koh-i-noor. No. 445,031. Class 8.—Crystals, detectors, and instruments and apparatus for use in wireless telegraphy and telephony. The Anglo-American Chemical Co., Ltd., 114-115, Great Saffron Hill, London, E.C.1. April 9th, 1924.

Filostat. No. 446,157. Class 8.—Electric resistances. Allen H. Soper, 22, Brandon Road, Brixton, S.W.2. April 9th, 1924.

Recent Contract.—The Belfast Electricity Committee has placed an order for a twelve-months' supply of lamps with the Siemens & English Electric Lamp Co., Ltd.

The Building Exhibition.—The Building Exhibition was opened at Olympia on April 11th by the Rt. Hon. J. H. Wheatley, Minister of Health; it will remain open until the 26th. The exhibition includes a number of interesting applications of electricity with which we hope to deal in our next issue.

Electricians' Wages.—The National Council for the Electricity Supply Industry has decided that the application by employés for a general increase of 10s. per week shall be dealt with by the District Councils. When the matter came before the No. 2 Council (Yorkshire, &c.), on April 9th, Mr. Proudler, on behalf of the men, stated the case for the advance, which was based principally upon the prosperity of the electricity supply industry. After some discussion, the employers' representatives said that a meeting of employers was being held on April 10th to consider the question, and the matter was therefore held over until this conference had stated its views.

Lighting and Power Notes.

Accrington.—STREET LIGHTING.—The Corporation has decided to supply electricity for street lighting at the rate of 1½d. per kWh.

NEW PLANT.—The Town Council has approved the recommendations of the electrical engineer and consulting engineer for extensions to generating plant, and application is being made to the Electricity Commissioners for sanction to carry out the scheme at an estimated cost of £55,000. The proposed extensions include one 6,000-kW turbo-alternator, condenser and auxiliaries, £27,000; foundations and flooring, £1,500; steam exhaust and water piping, £1,500; switchgear and cables, £1,500; two 25,000-lb. water-tube boilers, superheaters, &c., £13,000; boiler-house alterations and foundations, £2,000; feed pump, feed and blow-off piping, £1,500; cooling tower and tanks, £7,000.

Australia.—HYDRO-ELECTRIC DEVELOPMENT.—A meeting of representatives of responsible local governing bodies was held at Glen Innes on February 15th to formulate a scheme for providing an electricity supply for the northern portion of New South Wales. The Acting Prime Minister (Dr. Page) stated that the scheme proposed provides for a dam across the Clarence River above Grafton, 150 ft. in height, with the necessary plant and reticulation lines, to provide 40,000 h.p. The estimated cost of the scheme is £1,200,000; the cost of generation 1.23d. per kWh; and the cost delivered at the Tingha tin mines at Inverell, or at Lismore, 1.67d. per kWh, which would permit of its being sold at, say, 2½d. per kWh for power and at 6d. or 7d. for lighting. The project includes the formation of a county council from the shire and municipal councils in the area, and, if need be, to absorb the Nymboida scheme, which is now being completed by the Clarence River County Council. As an outcome of the meeting a motion was passed affirming the desirability of all the local governing bodies in the areas concerned entering into an agreement for organising and carrying out jointly the work of investigation, with a view to establishing a county council. A joint committee was appointed for this purpose. It was also decided that the Committee should prepare an agreement providing for the carrying out of the investigations, &c. The conference accepted the offer of Sir W. G. Armstrong, Whitworth & Co., Ltd., to undertake a preliminary survey and investigation of the proposals for the generation of electricity from the Upper Clarence River, known as the Jackadgery scheme.—*Industrial Australian and Mining Standard.*

Barrow.—ELECTRICITY SUPPLY.—At a recent meeting of the Town Council, the chairman of the Electricity Committee proposed the insertion of the parish of Egton-cum-Newland in the proposed Special Order for which application has been made to the Electricity Commissioners. The Committee reported that the electrical engineer had submitted a draft of a report upon the proposed scheme for a hydro-electric station at Backbarrow, on the River Leven, and that he had been given instructions to obtain further information thereon.

Barnes.—ELECTRICITY EXTENSIONS.—The Electricity Committee has recommended to the Urban District Council that application be made to the Electricity Commissioners for sanction to the borrowing of £22,940 for the following purposes:—Feeder cables, £13,440; sub-station, £1,500; plant, £3,000; and mains, £5,000.

Beckenham.—LOAN.—The Urban District Council is applying to the Electricity Commissioners for sanction to the borrowing of £5,850 for cables.

Bedwas and Machen.—ELECTRICITY SUPPLY.—At a meeting of the Urban District Council on April 1st, the Lighting Committee recommended that the scheme prepared by Mr. Ellis, electrical engineer, be adopted, and that application be made to the Electricity Commissioners for sanction to the borrowing of £6,225, representing the capital cost of the scheme.

Bexhill.—PROPOSED BULK SUPPLY.—In connection with the Town Council's application to the Electricity Commissioners for sanction to extend the plant at its electricity works, the Commissioners have replied that before they approve of the extensions the Council must ascertain the cost of obtaining a bulk supply of electricity from Hastings Corporation.

Blackburn.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £10,200 to purchase the fee simple of land at Whitebirk.

Boston.—STREET LIGHTING.—The Town Council has entered into an agreement with the Boston and District Electric Supply Co., Ltd., for lighting 104 street lamps by electricity for a period of ten years, from January 1st next, on the following terms:—60-watt gasfilled lamps, £5 10s. each per annum; 100-watt lamps, £8 2s. 6d.; 150-watt lamps, £11 6s. The company is to bear the expense of cables, brackets, reflectors and lamps.

Bradford.—ELECTRICITY SCHEMES.—The Electricity Committee is applying to the Electricity Commissioners for sanction to borrow £2,710 for the erection and equipment of a transformer chamber on a site in Peel Park.

In order to provide work for the unemployed the Electricity Committee has made the following suggestions:—(1) Construction of a reservoir for new cooling towers at the Valley Road generating station; (2) laying of cables in approved streets and roads.

Bristol.—CHANGE-OVER.—The Corporation is to change-over the single-phase portion of its system of electricity supply to 3-phase, 50 cycles, at 365 and 210 V.

Buxton (Derbyshire).—NEW PLANT.—The Town Council has adopted a scheme for the installation of one new set and the necessary structural alterations to the power station at an estimated cost of £6,000. Application is to be made to the South-East Lancashire Electricity Advisory Board for its approval of the scheme and to the Electricity Commissioners for sanction to borrow £6,000.

Cannock.—NEW SUB-STATION.—Having considered a report by Mr. S. T. Allen, electrical engineer, the Urban District Council has decided to erect a sub-station at Hednesford at an estimated cost, including switchgear, equipment and cables, of £1,085.

Carlisle.—LOAN.—The Electricity Committee has recommended to the Town Council that application be made to the Electricity Commissioners for sanction to a loan of £7,091, for the linking-up of mains, laying additional feeders, &c., extensions to switchboard platform, and switchgear.

Darlington.—LOANS.—Application has been made to the Electricity Commissioners for sanction to the following loans:—£3,000 for meters; £2,400 for switchgear, and an e.h.p. feeder cable; and £700 for the installation of a steam turbo-generator

ELECTRICITY ORDER.—A special amending Order is to be applied for extending the Council's area of electricity supply to include Croft, Hurworth and Haughton-le-Skerne, and application is to be made for permission to borrow £7,000, the estimated cost of this extension.

Eastbourne.—ELECTRICITY CHARGES.—The Electricity Committee has recommended the following new scale of electricity charges for business premises only:—(1) An alternative rate of £2 10s. per kW of maximum demand per quarter, plus 1½d. per kWh for all electricity used; (2) basement lighting at 1d. per kWh less than the normal flat rate; (3) shop-window lighting after closing hours, and electric signs at 3½d. per kWh, plus special meter rent of 7s. 6d. per quarter.

INAUGURATION OF NEW PLANT.—The new plant, which has recently been installed at the electricity works, is to be formally inaugurated on April 28th.

Greenock.—LOAN.—The Corporation is applying to the Electricity Commissioners for sanction to the borrowing of £112,000 in connection with schemes for centralising supplies.

India.—MANDI HYDRO-ELECTRIC SCHEME.—Work on the Mandi hydro-electric scheme is expected to commence shortly. According to *Commerce Reports*, written agreements to take an electricity supply exceeding 13,500 kW have been obtained by the Punjab Government from mill and factory owners, which, with the Government requirements, will bring the total up to 18,000 kW. Electrical energy will be distributed to 23 towns in the vicinity at an estimated cost of from ¾d. to 1d. per kWh. The cost of the scheme is estimated at 30,000,000 rupees.

London.—St. MARYLEBONE.—The Electric Supply Committee has recommended to the Borough Council that application be made to the Electricity Commissioners for sanction to the borrowing of £20,000 for mains and services to meet requirements up to March 31st, 1925.

Maidstone.—ELECTRICITY ORDER.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for an Order authorising the Corporation to supply electricity in the parishes of Barming, Bearsted, Boughton, Monchelsea, East and West Farleigh, Linton, Loose, Teston, Allington, Aylesford, Ditton, East and West Malling, Snodland, Wateringbury, Boxley, Detling, Hollingbourne and Thurnham. It is also recommended that application be made for sanction to a loan of £3,336 for extending the mains in the Loose area.

Malvern.—LOAN.—The Urban District Council has applied to the Electricity Commissioners for sanction to a loan of £5,000 for mains and services.

Northern Ireland.—BELFAST.—The Corporation has received the sanction of the Electricity Commissioners for Northern Ireland to the borrowing of £139,000 for electricity purposes.

Perth.—NEW PLANT.—The Electricity Committee has recommended that a new boiler be installed at the power station in addition to a turbo-generator.

Plymouth.—SPECIAL ORDER.—At a meeting of the Plymouth Corporation on April 7th the Electricity Committee recommended that application be made to the Electricity Commissioners for an Order authorising the Corporation to supply electrical energy for public and private purposes within the parish of Compton Gifford in the rural district of Plympton St. Mary. The estimated cost of the immediate work proposed is £4,725. The Council sanctioned the proposal.

Preston.—NEW POWER STATION.—On April 3rd members of the Town Council, at the invitation of the chairman of the Electricity Committee, paid a visit to the Ribble power station now in course of construction and rapidly approaching completion. The buildings, of the steel-frame type, are constructed of brick and concrete, reinforced with steel girders, and comprise a boiler house, turbine room, and office and switchgear building. The plant being installed consists of five Babcock & Wilcox boilers, which will supply steam to two turbo-generators, each capable of an output of 12,500 kW. Accommodation is also provided for a third set of similar capacity to be installed at a later date. The current will be generated at 6,600 V. The switchgear has been installed by Metropolitan-Vickers Electrical Co., Ltd.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

MERTHYR TYDVIL:—*Merthyr Electric Traction and Lighting Co., Ltd.*—Lighting: First 400 kWh per quarter, 8d. per kWh; next 50 kWh, 7½d.; beyond 7d. per kWh. Power: First 500 kWh per quarter, 4d. per kWh; next 500 kWh, 3½d.; next 1,000 kWh, 3d.; all energy in excess of this amount 2½d. per kWh.

WAKEFIELD.—Lighting: First 250 kWh per quarter, from 7½d. to 6½d. per kWh; next 750 kWh, from 6½d. to 6d. per kWh; all energy above this amount from 6d. to 5½d. per kWh.

CHISLEHURST.—*Chislehurst Electric Supply Co., Ltd.*—Lighting: From 9d. to 8d. per kWh, with a minimum charge of 10s. for the winter quarters and 6s. 8d. for the summer quarters.

FOLKESTONE.—*Folkestone Electricity Supply Co., Ltd.*—Lighting: From 7½d. to 7d. per kWh.

LEWES.—*Electric Supply Co., Ltd.*—Lighting: First 75 kWh per quarter, 9d. per kWh; next 50, 8½d. per kWh; all energy in excess of this amount, 8d. per kWh.

Retford.—ELECTRICITY SCHEME.—At a recent meeting the Town Council adopted a scheme to install plant at the Corporation gas works for the supply of electricity in the district. Application is to be made to the Electricity Commissioners for permission to carry out the scheme.

Sheffield.—LOAN.—The Finance Consultative Committee of the City Council has approved a recommendation of the Electricity Committee that application be made to the Electricity Commissioners for sanction to borrow £25,000 for mains necessary to supply electricity to houses to be erected on the Manor Estate.

MAINS EXTENSIONS.—The Electricity Committee has approved extensions of mains and overhead lines at a cost of £9,393.

Sunderland.—POOR LAW INSTITUTION LIGHTING.—The electrical installation of the Poor Law Institution was formally inaugurated on April 9th by the Mayor. The total cost of the scheme was £3,900.

Torquay.—ELECTRICITY ORDER.—The Electricity Commissioners have granted an Order to the Town Council for the supply of electricity to the parish of Cockington.

Truro.—ELECTRICITY CHARGES.—The Town Council has applied for an Order authorising it to charge a maximum price of 1s. per kWh for electricity, with minimum payments of 15s. for the winter quarters and 10s. for the summer quarters. The existing scale of charges is:—For any amount up to 20 kWh per quarter, 13s. 4d., and beyond, 8d. per kWh.

Welshpool.—APPLICATION FOR ORDER WITHDRAWN.—Having conferred with representatives of the North Wales Power Co. and the Gywnedd Trust, and received an assurance that the company's transmission line for a supply of electricity in bulk to Welshpool would be completed in 18 months, the Urban District Council has rescinded its resolution to apply for a Special Order for an electricity scheme, and has decided to support the application of the Gwynedd Trust for an Order subject to the terms of the Order being satisfactory to the Council.

Tramway and Railway Notes.

London.—NEW "UNDERGROUND" ROUTE.—The City and South London Railway has now been linked up with the Hampstead line by means of a new tube extending from Euston to Camden Town, a distance of one mile. Whilst the work has been proceeding, the northern section of the City and South London Railway from Euston to Moorgate has been undergoing entire reconstruction, and on Easter Sunday, April 20th, through services of trains will run between Hendon, Golder's Green, Highgate, and the City. Later in the year the remaining portion of the City and South London Railway from Moorgate to Clapham Common will be completed and will be reopened for traffic. Most of the stations are being entirely rebuilt and escalators installed. It is also expected that the further extension of the Hampstead line beyond Hendon to Edgware will be finished in July.

Longridge Light Railway.—The promoters of the Longridge to Hellifield Light Railway have received notice that the Unemployment Grants Committee has agreed to pay 3 per cent. annually on £100,000 of the ordinary share capital of the company for 15 years. The promoters have undertaken to absorb as many of the unemployed in the districts through which the line passes as possible.

Rochdale.—LOAN SANCTIONED.—The Ministry of Transport has sanctioned the borrowing of £8,500 to cover the cost of the tramway in Maclure Road and alterations to track at the corner of Tweedale Street and Manchester Road.

United States.—RAILWAY ELECTRIFICATION.—The Reading Co. (Philadelphia and Reading Railway), Philadelphia, Pa., has announced its intention to electrify its line between St. Clair and Frackville, Pa., at an estimated cost of $1,500,000. Preliminary plans and surveys are now under way for this improvement, which will include automatic sub-stations, line equipment, &c.

PROPOSED SUBWAY SYSTEM.—Following appeals from the Los Angeles Traffic Commission to take early action to relieve traffic congestion in the "downtown" district of the city, the City Council proposes to approve an appropriation of $40,000 to carry out an extensive transportation survey of Los Angeles. The survey is to be conducted under the supervision of Mr. F. A. Lorentz, chief engineer of the Board of Public Utilities. With the rapid automotive growth, it is considered necessary that a comprehensive subway system be planned and constructed and street cars be removed from the street surface.—*Electric Railway Journal.*

Telegraph and Telephone Notes.

A Notable Cable Feat.—THE REPARATION REPORT.—Last week the report of the Dawes Commission was cabled to New York for publication in full. The transmission of the report was carried out by arrangement with the Associated Press. The total number of words carried was 39,928, divided into messages of approximately 200 words each. The first message was filed at the Western Union Co.'s Paris office at 11.50 a.m. on April 8th, and delivered in New York on the opening of the Associated Press Office at 12.30 p.m., Greenwich time. Until 8 p.m., before which time the entire report was not in the hands of the Associated Press in Paris, the hourly rate of transmission was on an average 1,500 words; from 9 p.m. until 2.43 a.m. of April 9th, when the last message was delivered to the Associated Press in New York, the average hourly rate was approximately 4,400 words. This number of words was comfortably carried on two of the company's cables, and only during one hour was relief required from a third. The only transmitting point in the special circuits provided was at London. The delay here very rarely exceeded 30 minutes, except when it became necessary to hold messages back in order to maintain sequence to New York.

Long-distance Telephony.—LONDON-BERLIN SERVICE.—It is announced that public telephone communication between London and Berlin will shortly be possible over the new London-Emden cable.—*Financial Times.*

Norway.—NEW RADIO STATION.—Norway's newest and most northerly radio station is now completed and in commission at the town of Vardoe. For the present only a day service will be maintained. The station, while being of moderate power, is fitted with most up-to-date instruments, including a wireless telephone. The antannæ are stretched between two masts each over 150 ft. high. The power will be supplied from the Vardoe electricity works. Final transmission trials revealed that in addition to the other Norwegian stations, Helsingfors, Spitzbergen, and Jan Mayen (300 miles east of Greenland) could also be reached. The station's weather and other reports are likely to be of immense service to British and other trawlers fishing in Arctic waters.—*Reuter* (Christiania).

Pacific Cable Board.—EXTENSION OF POWERS.—A Bill has been presented to the House of Commons by Mr. Secretary Thomas, and is supported by the Chancellor of the Exchequer, which has been framed to enable the Board, subject to the approval of each of the Governments represented on it, to undertake as agents for and at the expense of the Governments of any parts of the Dominions any work in connection with telegraphic communication, whether by means of cables or radio telegraphy, without any restriction as to the geographical limit of their operations. Any work undertaken by the Board as agents for His Majesty's Government before the Bill becomes an Act in connection with any transatlantic cable worked by that Government shall be deemed to have been within the powers of the Board. The Board, in the event of its undertaking work in connection with telegraphic communication in the West Indies, shall have power to provide and supply to the West Indies a news service similar to that supplied by telegraph companies at the time this Bill becomes an Act.

U.S.A.—RADIO MONOPOLY BILL.—The Senate on April 10th adopted a Bill to prevent a monopoly of radio communication.

The measure declares the air to be the inalienable possession of the people, and prohibits licences of a duration of more than two years.—*Reuter* (Washington).

West Indies.—TELEGRAPH COMMUNICATION.—A Bill has been introduced in Parliament which makes provision for the laying of a submarine cable between Turks Islands and Barbados, and for the establishment of communication, either by cable or radio stations, between Barbados, Trinidad, British Guiana, Saint Kitts, Antigua, Dominica, Saint Lucia, Saint Vincent, and Grenada. Any sum required for the repayment of money borrowed under this Act and for the annual expenses of working the system (including interest on borrowed money) shall, so far as not covered by receipts, be ultimately provided by the Governments of the various parts of the Dominions concerned, and profits arising from the working of the system shall be divided between the Governments in the same proportions. The Treasury shall issue out of the Consolidated Fund sums not exceeding £400,000 for defraying the cost of the provision of such cables and stations and of working capital.

Radio Notes.

Belgium.—BROADCASTING COMMISSION.—Radio concerts are broadcast daily from Brussels, but the Government has not yet authorised the transmission of messages by amateurs, although in certain cases permission has been granted to large schools and universities. An interministerial commission, however, will convene within a short time for the purpose of discussing various questions relative to the use of radiotelegraphy by amateurs. It is expected that delegates representing manufacturers of radio apparatus, as well as representatives of amateur societies, will be present at the conference.—*Commerce Reports.*

Germany.—HOTEL RECEIVERS.—One of the large hotels in Berlin is, according to the daily Press, installing radio receiving outfits in all its rooms.

Receiving Licences.—The Postmaster-General, Mr. V. Hartshorn, has announced in Parliamentary papers that the number of broadcast radio receiving licences in existence on March 31st, 1924, was approximately 720,000.

Spain.—BROADCASTING.—The President of the Directory, General Primo de Rivera, personally broadcast a message to the Spanish people last Saturday evening on a wavelength of 2,000 metres.—*Reuter* (Madrid).

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Argentina.—BUENOS AIRES.—May 28th. Department of Sanitary Works. Electrical power plant for the pumping station at Pergamino.*

Barnes.—May 12th. Electricity Department. Two 500-kW rotary or motor converters, with h.p. and l.p. switchgear. (April 11th.)

Belfast.—May 5th. Electricity Department. D.c. switchgear for sub-stations. (See this issue.)

Belgium.—ST. GILLES.—May 9th. Municipal Council. Armoured cables.*

April 23rd. Belgian Post and Telegraph authorities, at La Salle Madeleine, Brussels. 2,000 microphones and 2,000 bell sets, with condensers. Particulars (cahier des charges special No. 3-17) for 95 centimes.

April 23rd. Belgian State Railway authorities (Office de l'Electricité), 25, Rue de la Charité, Brussels. H.p. transformer station at Stockem-Arlen. Particulars (cahier des charges special No. 1,399) for 90 centimes.

April 30th. Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. 9,007 metres of lead-covered, paper-insulated telephone cable in two lots of respectively 3,747 and 5,260 metres. Particulars (cahier des charges special No. 3-7) for 4 fr. 60 c.

May 8th. Municipal authorities of Goyer (Province of Limbourg). Establishment of a system of l.p. electricity distribution in the town. Particulars (25 fr.) from the Secretaire Communal, Goyer.

Bri Chualann.—May 6th. Urban District Council. Electrical stores. (See this issue.)

Cardiff.—April 24th. Electricity Department. One 5,000-kW turbo-alternator and condensing plant. (April 4th.)

Chile.—SANTIAGO.—May 26th. Chilean State Railways. Telephones, switchboards, copper and g.i. wire and cables, dry cells, insulators, &c.*

Denmark.—COPENHAGEN.—April 25th. Municipal Council. Electrically-driven gas pump.*

Dublin.—April 30th. Electricity and Public Lighting Committee. Flame carbons. (April 4th.)

April 23rd. Commissioners of Public Works, Dublin. Electrical works and supplies in the district of Dublin for six months. Mr. J. J. Healy, secretary, Dublin.

Edinburgh.—May 12th. Electricity Supply Department. Extensions to d.c. switchboard.

Glasgow.—April 26th. Electricity Department. Cables, meters, and carbons for 12 months. (April 11th.)

Grimsby.—May 2nd. Electricity Department. 3,000 yd. 6,600-V feeder, cable and pilot cable, and 3,000-yd. distributor cable. (See this issue.)

Hornsey.—April 26th. Electricity Works. L.p. generator and feeder switchboards. (April 11th.)

London.—STEPNEY.—May 1st. Electricity Supply Committee. Coal-handling plant and ash-handling plant for the Limehouse generating station. (April 4th.)

SOUTHWARK.—May 1st. Board of Guardians. Installation of a complete electric lighting scheme at the Southwark Hospital, East Dulwich Grove, S.E. (April 11th.)

ST. MARYLEBONE.—April 30th. Electricity Supply Committee. L.p. and e.h.p. cables for 12 months. (April 11th.)

LONDON COUNTY COUNCIL.—May 5th. H.p. switchgear, control panels, &c. (April 11th.)

May 19th. Motor-driven belt-conveyor, coal-handling plant for Greenwich power station. (See this issue.)

Manchester.—May 2nd. Electricity Committee. 6,600-V, 3-phase switchgear for sub-stations. (April 11th.)

New Zealand.—WELLINGTON.—July 1st. Public Works Department. Pipe lines for the Lake Coleridge electric power scheme.*

AUCKLAND.—June 23rd. Electric Power Board. One 5-ton electric travelling crane.*

WAIROA.—May 1st. Town Council. Centrifugal pumps and electric motors.*

Newport (Mon.).—May 1st. Electricity Department. 750-kW and 300-kW rotary converters, 500-kW house turbo-alternator, and ash-handling plant. (April 11th.)

Renfrewshire (Paisley).—April 21st. Education authority. Electrical work in connection with new administrative offices. Mr. J. Hamilton Pullar, Executive Officer, County Education Offices, Paisley.

South Africa.—JOHANNESBURG.—May 9th. Rand Water Board. Five coal elevators and 10 coal chutes at Zwartkopjes.*

Southampton. — April 30th. Electricity Department. E.h.p. 3-phase cables, e.h.p. switchgear, 3-phase transformers. (April 11th.)

Stoke-on-Trent.—May 14th. Electricity Department. Circulating water pipes and valves, steam pipes and valves. (See this issue.)

Stockton-on-Tees.—May 5th. Electricity Department. Two 300-kVA, 3-phase transformers. (See this issue.)

St. Helens.—April 25th. Electricity Department. One 1,000-kW motor converter. (April 11th.)

Warrington. — April 29th. Electricity Department. Steam pipes and water pipes. (April 11th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Australia.—BRISBANE.—The Brisbane Tramways Board has accepted Messrs. Dorman, Long & Co.'s tender for the manufacture in England of a further 1,500 tons of tram rails and fastenings for delivery after the completion of the present contract for 15,000 tons. The price is not stated.—*Reuter's Trade Service* (Brisbane).

Barrow.—Town Council. Accepted:—

Water-tube boiler (£3,800).—Stirling Boiler Co., Ltd.
Chain-grate stokers (£3,042).—Babcock & Wilcox, Ltd.
Removal and re-erection of boilers, Nos. 6 and 7 (£408).—J. Morgan.
Switchgear (£1,336).—Metropolitan-Vickers Electrical Co., Ltd.
Automatic voltage regulator (£170).—Cox-Walker & Partners.

Supply of goods for six months ending September 30th. Accepted:—

Copper wire.—Ward & Goldstone, Ltd.
E.h.p. compound, tin lead fuse wire, lead wire, switch cut-outs, &c.—British Insulated & Helsby Cables, Ltd.
Insulating compound and bitumen.—The Dussek Bitumen Co.
Cord grip lampholders, tumbler switches, switch lampholders, brass, bronze, and flanged lampholders.—Simplex Conduits, Ltd.
D.c. meters.—Chamberlain & Hookham, Ltd.
S.p. meters.—Landis & Gyr, Ltd.
D.c. and a.c. prepayment meters.—Ferranti, Ltd.
Half-watt-type metallic-filament and carbon-filament lamps.—W. R. Thornton & Sons, Ltd.
Earthenware socket pipes and bends.—Doulton & Co., Ltd.
Earthenware troughs and lids, U-shaped.—Oates & Green, Ltd.
Meter boards.—E. Last.
Close-jointed steel conduit.—Edison Swan Electric Co., Ltd.

Belgium.—The Belgian State Railway authorities in Brussels recently invited tenders for the supply and installation of six lots of l.p. reception and distribution switchboards. The lowest offer for five of the lots was that of Depaifve and Olivier, of Schaerbeek, while the remaining lot fell to M. C. Richez, of Brussels.

Four Belgian concerns submitted tenders last week to the municipal authorities of Schaerbeek, Brussels, for the supply of 600 circuit breakers, the lowest offer being that of Messrs. Depaifve & Olivier, of Schaerbeek.

Carlisle.—Electricity Committee. Accepted:—
Switchgear (£955).—Bertram Thomas.

Dublin.—The Electricity Committee has recommended the acceptance of the tender of Oerlikon, Ltd., for an additional 2,000-kW turbo alternator, with condensing plant, pipework, and accessories, at £31,188, and has also accepted the offer of the company to carry out, free of charge, certain repair work on the existing 5,000-kW turbine, and, further, to make an allowance of £1,000 on the new contract.

France.—The French State Railway authorities in Paris have lately placed a contract with the Société La Canalisation Electrique, of Paris, for the supply of 5,000 metres of 7-mm. insulated cable; and with the India Rubber, Gutta Percha, and Telegraph Works, of Persan, for 8,200 metres of 20-mm. cable.

Kendal.—Town Council. Accepted:—
Installing electrical fittings at the Market Hall.—F. S. Reed & Son.

London.—St. Pancras.—Electricity and Public Lighting Committee.
Six 1,500-kW motor converters:—

General Electric Co., Ltd.	£31,926
British Thomson-Houston Co., Ltd.	32,685
Bruce Peebles & Co., Ltd. (Recommended.)	**33,164**

Eleven sets of Bruce Peebles' manufacture have been in successful operation in the undertaking for a considerable period, and have cost practically nothing for repairs.

The Committee, after careful consideration, is of opinion that it would be preferable for all plant of this type in the undertaking to be of uniform design, and also, having regard to the reliability which the chief electrical engineer has experienced with plant by Messrs. Bruce Peebles & Co., Ltd., recommends that, subject to the consent of the Electricity Commissioners, the tender of Messrs. Bruce Peebles & Co., Ltd., at £33,164, be accepted. Two sets are to be delivered in five months, two sets in six months, and the remaining two sets in nine months.

St. Marylebone.—Electricity Supply Committee. Recommended:—
10 automatic circuit breakers (£390).—Park Royal Engineering Co., Ltd.
Replacing one motor-driven circulating-water pump and fitting new impeller to second pump (£465).—W. H. Allen, Son & Co., Ltd.

Stepney.—Electricity Committee. Recommended:—
Supply of cable for 12 months:—

Hackbridge Cable Co., Ltd.	£7,693
W. T. Henley's Telegraph Works Co., Ltd. (Recommended.)	**7,945**
W. T. Glover & Co., Ltd.	8,063
British Insulated & Helsby Cables, Ltd.	8,079
Pirelli-General Cable Works, Ltd.	8,084
Siemens Bros. & Co., Ltd.	8,111
Western Electric Co., Ltd.	8,133
Macintosh Cable Co., Ltd.	8,322
Callender's Cable & Construction Co., Ltd.	8,513

Rewiring work in connection with the new turbines (£82).—British Insulated & Helsby Cables, Ltd. (Accepted.)
Prepayment meters (£362).—Ferranti, Ltd. (Accepted.)

Middlesbrough.—Corporation. Accepted:—
Feeder pillars (£165).—British Insulated & Helsby Cables, Ltd.

Northampton.—Town Council. Accepted:—
Rails and material for track work for the tramcar shed extensions (£799).—Edgar Allen, Ltd.

Portsmouth.—Town Council. Accepted:—
13 automatic point controllers for the tramways (£845).—Forest City Co.

Sheffield.—Electricity Supply Committee. Accepted:—
Erection of transformer sub-stations.—Ash, Son & Biggin (£1,095); W. J. Gleeson (£312).

Stockton-on-Tees.—Town Council. Accepted:—
H.p. and l.p. cable and overhead lines for the Bowesfield and Hartburn extensions (£4,334).—British Insulated & Helsby Cables, Ltd.

West Ham.—Education Committee. The following tenders were received for the electrical wiring and fittings at 12 schools. Architect, Mr. J. H. Jacques:—

Commercial Telephone & Electrical Co., Ltd.	£6,847
Eastern Armature Winding Co.	8,390
Evans (Electrical), Ltd.	9,837
Guild of Engineers (London), Ltd.	7,072
Guild Housing, Ltd.	8,029
J. T. Halsey & Sons	7,836
Higginbotham & Sons	6,835
Knowsley Electrical Co., Ltd.	8,025
Manley & Regulus, Ltd.	7,099
H. H. Mills	8,381
Ohms, Ltd. (Accepted.)	**6,234**
D. Rowan	18,703
Thorby & Matthews, Ltd.	5,285
Troup, Curtis & Co., Ltd.	9,750
West Ham Corporation Electricity Department	9,804

Forthcoming Events.

Electrical Trades Union and Electricity Supply Commercial Association.—Wednesday, April 23rd. At the Royal Horticultural Hall, Vincent Square, S.W. From 7 till 11.30 p.m. Dance.

West of Scotland Electricity District.—Wednesday, April 23rd. In the Justiciary Buildings, Jail Square, Glasgow. At 10.30 a.m. Electricity Commissioners' local inquiry.

Institution of Electrical Engineers.—Thursday, April 24th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Fifteenth Kelvin Lecture, "Kelvin and the Economics of the Generation and Distribution of Electrical Energy," by Mr. G. Semenza.

(Scottish Centre).—Friday, April 25th. At the Technical Institute, Dundee. At 7.30 p.m. Paper on "The Characteristics of a d.c. Series Machine Self-excited by Rectified Current for the Purposes of Regenerative Control," by Mr. R. D. Archibald.

Birmingham and District Electric Club.—Friday, April 25th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Electric Lifts," by Mr. C. A. Munsen.

Junior Institution of Engineers.—Friday, April 25th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Aluminium Electrical Conductors for Overhead Power Transmission," by Mr. H. G. Williams.

Notes.

National Institute of Industrial Psychology.—The Rt. Hon. the Earl of Balfour, K.G., O.M., has accepted the position of President of this Institute. He is the first President to be appointed and will preside at the Institute dinner to be held at the Victoria Hotel, Northumberland Avenue, W.C., on Thursday, May 29th, when the Rt. Hon. Tom Shaw C.B.E., Minister of Labour, and Sir Hugh Bell, Bart., C.B., will be among the guests of the Institute and will speak. We understand that in addition to the Colliery Investigation for which the Institute has been retained by the Mining Association of Great Britain and the interesting Vocational Guidance and Selection research which is being generously subsidised for the next two years by the Carnegie Trustees, the Institute has recently been retained to carry out investigations for one of the largest and best known London gas companies.

Social Events.—On April 11th, the staff of the Electrical Apparatus Co., Ltd., and a number of visitors met at dinner at the Connaught Rooms, W.C.2. After an excellent dinner, the digestion of which was aided by a trio of Highland pipers, a fairly long toast list was gone through. Mr. T. K. Evans humorously proposed the toast of "The E.A.C.," and Mr. R. H. Barbour (the chairman) responded on behalf, as he said, of not only the directors and shareholders, but also the employés, their dependants, and the company's customers. Other toasts were "The Manufacturing Staff," "The Sales Staff," and "The Visitors." The speech-making was relieved by a number of musical items interspersed between the toasts.

The Brook, Hirst Athletic Club held its eighth whist drive and dance of the season at Chester last week. There was a record attendance of over 500 persons. Altogether 17 prizes were distributed during the evening.

Faraday House Concert.—Old students are reminded that the annual smoking concert will be held at the Hotel Cecil (Princes Hall) on May 2nd, at 8 p.m., with the president, Mr. R. N. Vyvyan, M.I.E.E., in the chair. Accommodation will be available for 300.

The Development of Electrical Cooking Apparatus.—A paper on this subject was read by Mr. F. Smith (Jackson Electric Stove Co., Ltd.) at a sales conference, organised by the E.D.A. sub-committee of the West Riding (Aire and Calder Electricity District), which was held at Leeds on April 3rd. In comparing modern apparatus with earlier types, Mr. Smith said that the outstanding difference was that while up-to-date appliances were reparable at a low cost by comparatively unskilled men, the older apparatus was either not reparable at all, or, if it was, it could only be repaired by skilled men and special processes. The very early electric ovens were heavy, clumsy appliances, and were most probably converted gas ovens. They consisted of a heavy cast-iron body, double-cased, lagged, and fitted with an internal framework to which heavy heated plates were attached. The next type went to the other extreme; they were too lightly constructed. The present design of oven consisted of a light cast-iron base supported on four legs. This base supported the oven body, which was fitted with a light cast-iron front frame on which the door was hinged. The oven consisted of two sheet-steel casings, the space between being packed with heat-insulating material. The door was of cast-iron, and when closed made a good tight joint with the front frame, forming a completely closed chamber. Cast-iron, mica, and other elements had been superseded largely by spiral elements fitted in fire-clay bases. Connections had been improved by the substitution of rigid bus-bars for the beaded-wire and other connections. The speaker expressed an opinion that the side-heated oven was the best, although he admitted that top and bottom elements were satisfactory. After reviewing the development of the hot-plate, the speaker said that the first real attempt to solve the question was the substitution of an open-type plate, with a spiral element wound on insulators, for the heavy closed-in plates. The elimination of a separate control board by fixing the switches and fuses on the oven itself had considerably cheapened and simplified electric cookers; the series-parallel rotary switch was a good development. Mr. S. C. Hurry (Jackson Electric Stove Co., Ltd.) then read a paper on "Electric Cooking and Heating from the Manufacturer's Point of View." He said that the manufacturer had to satisfy both the engineer and the cook. The latter should receive the greater consideration; there was, unfortunately, still a tendency to produce a sound electrical job at the expense of the sound cooking article. Cookers should be lightly but strongly constructed, as the majority were supplied under hire schemes, with payment for them spread over a period of years based on the life of the cooker. Strangely enough, a cooker designed to give the highest electrical efficiency would not

be tolerated in the kitchen—the "gas type" cooker still possessed the favour of housewives. Four types of cooker were generally needed, catering, respectively, for 2-3, 3-4, 5-6, and 9-10 persons. This was important, as nobody would wish to purchase a cooker of too large a capacity.

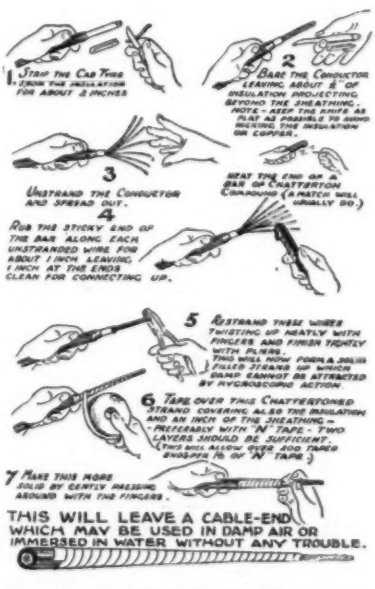
The manufacturer kept in mind the desirability of making parts interchangeable; he not only had to think of the first cost, but also of the cost of spares and subsequent service. The electric cooking business was never so flourishing as it was now; the price of energy was being brought to a more reasonable figure enabling it to be used for cooking.

Mr. Hurry appealed to supply authorities to use the cookers for at least a year before attempting to re-design them. The constant changing of type was a costly business. The manufacturer was always willing to listen to suggestions for improvement, but he could not follow too closely the whims and fancies of every individual buyer. A purchaser must be prepared to order from 500 to 1,000 cookers if alterations to standard models were required without an increase of price.

The Inventions Commission.—The Inventions Commission sat in private on April 7th to hear a claim by Mr. Frank E. Smith in relation to the "M" unit.

Local Societies.—Turbine Construction.—At a meeting of the Edinburgh Electrical Society on April 4th, Mr. E. Seddon delivered a lecture, in the course of which he dealt with the design of various types of steam turbines, and also embraced the subject of condensers, giving much useful information concerning the maintenance of such plant, and concluded with a description of the Portobello power station.

Protecting Cable Ends from Moisture.—We reproduce herewith illustrations of a method of dealing with cable ends


1. STRIP THE CAB TYRE FROM THE INSULATION FOR ABOUT 2 INCHES
2 BARE THE CONDUCTOR LEAVING ABOUT ½" OF INSULATION PROJECTING BEYOND THE SHEATHING. NOTE - KEEP THE KNIFE AS FLAT AS POSSIBLE TO AVOID NICKING THE INSULATION OR COPPER.
3 UNSTRAND THE CONDUCTOR AND SPREAD OUT.
HEAT THE END OF A BAR OF CHATTERTON COMPOUND (A MATCH WILL USUALLY DO.)
4 RUB THE STICKY END OF THE BAR ALONG EACH UNSTRANDED WIRE FOR ABOUT 1 INCH LEAVING 1 INCH AT THE ENDS CLEAN FOR CONNECTING UP.
5 RESTRAND THESE WIRES TWISTING UP NEATLY WITH FINGERS AND FINISH TIGHTLY WITH PLIERS. THIS WILL NOW FORM A SOLID FILLED STRAND UP WHICH DAMP CANNOT BE ATTRACTED BY HYGROSCOPIC ACTION.
6 TAPE OVER THIS CHATTERTONED STRAND COVERING ALSO THE INSULATION AND AN INCH OF THE SHEATHING - PREFERABLY WITH "N" TAPE - TWO LAYERS SHOULD BE SUFFICIENT. (THIS WILL ALLOW OVER 200 TAPED ENDS PER lb OF "N" TAPE.)
7 MAKE THIS MORE SOLID BY GENTLY PRESSING AROUND WITH THE FINGERS.
THIS WILL LEAVE A CABLE-END WHICH MAY BE USED IN DAMP AIR OR IMMERSED IN WATER WITHOUT ANY TROUBLE.

Method of Protecting Cable Ends from Moisture.

to prevent the ingress of moisture and damp, which are being circulated by the St. Helens Cable & Rubber Co., Ltd.

Educational.—Faraday House Electrical Engineering College.—As a result of the entrance scholarship examination held on April 8th, 9th, and 10th, the following awards have been made:—W. J. L. Wildbore, Strand School, Brixton Hill, the "Faraday" Scholarship of fifty guineas per annum (two years in college and one year in works); D. Parkinson, Victoria Grammar School, Ulverston, the "Maxwell" Scholarship of fifty guineas per annum; F. A. Peachey, Royal Grammar School, High Wycombe, an exhibition of forty guineas per annum; J. G. Bentley, Merchant Taylors School, and C. F. Ellis, Beckenham County School, each an exhibition of thirty guineas per annum, these four being tenable for one year in college and one year in works; W. A. R. Smith, King Edward VI Grammar School, Norwich, an entrance prize of twenty guineas.

London's Electricity Supply.—In the agenda for last Tuesday's meeting of the London County Council two reports of importance in connection with the reorganisation of electricity supply in London appeared from the Special Committee on London Electricity Supply. The first dealt with the negotiations between the Committee and the London Electricity Joint Committee (1920), Ltd. (the companies' organisation). The recommendations attached to this report were, briefly, as follows:—That agreements be entered into with the Joint Committee and with the "County of London" group to give effect to previous resolutions of the Council regarding the setting up of a Joint Electricity Authority, the extension of the companies' tenure, the settlement of a sliding scale of charges, the regulation of dividends, the co-ordination of the systems, &c.

The second report was in connection with the Electricity Commissioners' Draft Order for the London and Home Counties Area. The Committee considered that this "substantially meets the requirements which have been laid down by the Council as essential to any scheme for the reorganisation of electricity supply in Greater London." Power is sought by the Committee to be able to make any necessary amendments in matters of detail, as, for instance, the insertion of protective clauses.

Appointments Vacant.—Demonstrators (lady and gentleman) for the Yorkshire Electrical Power Co.; commercial assistant (£350) for the Watford Electricity Works; senior assistant electrical engineers for the Newcastle-upon-Tyne Electric Supply Co., Ltd. (See our advertisement pages to-day.)

Institution Notes.

Institution of Electrical Engineers.—Faraday Medal.—The Faraday Medal of the Institution of Electrical Engineers will be presented to Dr. S. Z. de Ferranti on April 24th, prior to the meeting at which Mr. G. Semenza, of Milan, will deliver the Fifteenth Kelvin Lecture; he will take as his subject "Kelvin and the Economics of the Generation and Distribution of Electrical Energy."

The Mascart Medal.—At the meeting on April 10th the president announced that the French Society of Electricians had decided to award a medal of honour triennially, irrespective of nationality, and that the first recipient was Prof. André Blondel, Hon. M.I.E.E.

Wireless Section Committee.—The following gentlemen have been nominated by the Wireless Section Committee to serve from October 1st, 1924:—*Chairman*: E. H. Shaughnessy, O.B.E. *Ordinary members*: Prof. C. L. Fortescue, Captain N. Lea, B.Sc., C. F. Phillips, and Commander J. A. Slee, C.B.E. The following will continue to serve as members of the Committee: The President of the I.E.E., the Chairman of the I.E.E. Papers Committee, a nominee of the I.E.E. Council, a nominee of the I.E.E. General Purposes Committee, S. Brydon, D.Sc., C. F. Elwell, Prof. G. W. O. Howe, D.Sc., Admiral Sir H. B. Jackson, G.C.B., F.R.S., J. St. Vincent Pletts, Captain H. R. Sankey, C.B., C.B.E., R.E., R. L. Smith-Rose, Ph.D., M.Sc., C. F. Trippe, together with Major R. Chenevix-Trench, O.B.E., M.C. (nominated by the War Office), Captain C. E. Kennedy-Purvis, R.N. (nominated by the Admiralty), Major A. G. Lee, M.C. (nominated by the Post Office), and Major H. P. T. Lefroy, D.S.O., M.C. (nominated by the Air Ministry).

Irish Centre.—"The present-day electrical atmosphere is dense with development schemes," said Mr. J. A. Kenny, A.M.I.E.E. (of the firm of Messrs. J. P. Tierney and Co., consulting engineers, Dublin) when lecturing on the subject of small power supply schemes before the Irish Centre of the Institution last week. The number of public schemes in Ireland, he added, was 136, which proved that Ireland, in proportion to her size, population, and state of industrial development, possessed more self-contained public supply schemes than any other country in the world. Dublin, in 1879, was the first town to give a public supply of electricity. He contended that the factory or individual supply, if properly worked, would be the best and cheapest for many of the country towns, but the result was always to be deplored, and the public authority and the private company were the only two alternatives. An ideal way of surmounting the difficulties of management might be in merging the public authority with a private company, and, governed by this idea, one of their schemes had been promoted. Under the Electricity Act, at present under consideration, even greater facilities would be available.

Junior Institution of Engineers.—On April 4th, Mr. A. J. Sear, A.R.C.S., delivered a "lecturette" on "Mineral Oils, with special reference to Lubricating and Insulating Oils." After dealing briefly with the mining and treatment of crude oils, Mr. Sear described the physical and chemical properties by which lubricating and insulating oils are usually tested and specified. He said that an investigation of the amount of surface tension of an oil would give much more indication of its lubricating qualities than any viscometer or other test. The tendency of oil to sludge, he said, occurred when the oil was heated and could oxidise, and although at one time sludging in transformers was thought to be due to electrical action, it was now proved that it arose from purely chemical sources. The question of a proper setting point for transformer oil had to be decided on the merits of each particular case; a high flash point could not be obtained with a low setting point. The lecturette was illustrated by a number of slides showing oil fields and boring plant, testing apparatus, and also electrical plant which had suffered injury through defects in the oil used in connection with it.

The Royal Institution.—The Tyndall Lectures will be delivered this year by Major M. S. Tucker, Director of Sound Ranging in the Army, on "Acoustical Problems." On Thursday afternoons, May 15th and 22nd, Dr. E. V. Appleton will deliver two lectures on "Atmospheric Interference in Wireless Telegraphy." The Friday evening meetings will be resumed on May 2nd, when Sir Alexander Kennedy will deliver a discourse on "Petrn."

The Faraday Society.—A general discussion on "Fluxes and Slags in Metal Melting and Working" is to be held on Monday, April 28th, by the Faraday Society and the Institute of Metals, with the co-operation of the British Non-Ferrous Metals Research Association and the Institute of British Foundrymen. The meeting will be held from 3 p.m. to 7 p.m., with an interval for tea, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. A general introduction will be given by Prof. C. H. Desch, and there is a programme of some 14 papers intended to initiate discussion on the various aspects of the subject. The papers deal primarily with the uses of fluxes and slags in the smelting and refining of the non-ferrous metals, but there will be one section dealing with fluxing problems in arc and oxy-acetylene welding. The subject of slag inclusions will also be dealt with. A copy of the complete programme may be obtained from the Secretary of the Faraday Society, 10, Essex Street, London, W.C.2.

Radio Society of Great Britain.—POSTPONED MEETING.—The ordinary general meeting of the Society, originally arranged for April 23rd, has been postponed until Wednesday, April 30th, 1924. The meeting will be held at 6 p.m., at the Institution of Electrical Engineers, and will be the occasion of an interesting lecture by Captain P. P. Eckersley, on "Faithful Reproduction by Broadcast."

Institute of Metals.—COUNCIL'S REPORT.—The report of the Council for the year ended December 31st, 1923, shows that the membership of the Institute increased from 1,436 to 1,531, the growth of 95 being above the average for the past five years, and far more papers were offered than could be accepted. Financial limitations still impose restrictions upon the activities of the Institute in other directions than that of publication. The activities of the six local sections have further developed during the year, and financial assistance, to the extent of £100, was given during the year to them from the funds of the Institute. The Council considered a scheme for sharing with certain other allied institutions a portion of a large, new, centrally-placed office building, but was unable to proceed with the scheme, owing to the increase in expenditure involved. The report of the treasurer shows that the prime reason for over-expenditure is that they are giving members too good value in the form of the publications that they receive, while they spend nearly 50 per cent. of their income on their journal. Other institutions expend only from 25 to 30 per cent. On the other hand, only about 30 per cent. of the income is expended on salaries, as compared with over 40 per cent. expended by several institutions. The income for the year was £5,464, and the deficit amounted to £403.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. WILLIAM A. A. BURGESS, M.I.E.E., has resigned his position as chief electrical engineer to the British Dyestuffs Corporation, Ltd., to take up an appointment with Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne. We understand that Mr. Burgess has been responsible for the development and operation of the former company's electrical system and the special uses of electricity incidental to the manufacture of explosives and dyes almost from the inception of the original company, British Dyes, Ltd., and shortly after the amalgamation of that company with Messrs. Levinstein, Ltd.; he was appointed chief electrical engineer to the present amalgamated company, and took over the electrical side of the various additional factories involved. On his departure Mr. Burgess was presented with a gold watch and a canteen of cutlery by his colleagues, the presentations being made by Mr. W. L. Wade, resident electrical engineer at the Huddersfield works, and Dr. J. C. Burnham, general manager.

Prior to their meeting, on March 28th, members of the Diesel Engine Users' Association met at the Coventry Restaurant to entertain their honorary secretary at luncheon. The function was arranged to commemorate the tenth year of Mr. PERCY STILL'S tenure of the office, and advantage was taken of the occasion to present an inscribed gold watch and chain to the guest. In making the presentation, Mr. A. W. A. Chivers, the president, spoke of the esteem in which Mr. Still was held, and of the unselfish manner in which he devoted his time and energies to the affairs of the Association. Mr. Still, in responding, expressed his appreciation of the wholly unexpected gift.

Mr. W. YUILLE has relinquished his position with Messrs. John T. Cartwright, of Glasgow, in order to take up the appointment on May 1st of Scottish representative of the Foster Engineering Co., Ltd., with office in Glasgow.

The salary of Mr. H. C. DAY, manager of the Heywood Corporation Electricity and Tramways Department, has been increased by £25 per annum from April 1st, with a further £25 per annum from October 1st next.

The Accrington T.C. has increased the salary of the borough electrical engineer to £866 per annum, including bonus.

Mr. W. J. CHESTER, who for the past three years has controlled the Installation Section of the Wolverhampton Corporation Electricity Department, has now been appointed contracts manager by the Western Electric Distribution Corporation, Ltd., for the West Wiltshire area. On behalf of the Wolverhampton staff the chief engineer, Mr. S. T. Allen, presented Mr. Chester with a mahogany clock and candlesticks.

Mr. G. E. LEARNARD, president of the International Combustion Engineering Corporation of New York City, who recently sailed for New York after visiting this country in connection with the formation of the Vickers and International Combustion Engineering, Ltd., will return in September.

Mr. E. KILBURN SCOTT, M.I.E.E., has charge of the publicity department of the Vickers & International Combustion Engineering, Ltd., and assists with the sales engineering.

We learn that Mr. L. J. ELLACOTT GENNER, who for some years past has been responsible for the Western Electric Co.'s advertising, is transferring his services to the "Paint More Campaign" of the National Federation of Paint, Colour, and Varnish Manufacturers of Great Britain. He leaves the electrical industry with the good wishes of a host of friends.

MR. ARTHUR GRAY states that he has resigned his position as managing director and secretary of the Gray Electrical Co., Ltd., 110, Charing Cross Road, London, W.C.2.

Obituary.—MR. E. JONES.—The death has taken place of the age of 61 years, of Mr. E. Jones, permanent-way inspector of the Yorkshire (Woollen District) Electric Tramways Co., with whom he had been for upwards of 21 years.

MR. T. L. BELL.—The death took place, on April 6th, of Mr. Thomas Leonard Bell, chairman of the Hull Road Motor and Electrical Engineering Co., Ltd. Deceased was 57 years of age.

New Companies Registered.

The Helio Dynamo Co., Ltd. (197,115).—Registered as a private company on April 8th, with a nominal capital of £20,000 in £1 shares (8,000 "A" and 12,000 "B"). The "A" shares are entitled to 40 per cent. of the net profits and the "B" shares the remaining 60 per cent. The objects are:—To acquire from Dr. A. Marcuse, of 12, Dahlmannstrasse, Charlottenburg, Berlin, certain rights in an invention of a process and device for making use of the heat of the sun, to acquire the British and other patents for the same; to acquire patent No. 146,820, of 1921; to adopt an agreement with the vendor through his attorney Touvie Wolk and the said Touvie Wolk as an individual; and to carry on the business of manufacturers of machines, instruments and machinery, importers of and dealers in machines, instruments, machinery, metal, glass, rubber and all material used in the manufacture of machines or instruments, &c. The subscribers (each with one share) are:—Samuel Landman, Sentinel House, Southampton Row, W.C., solicitor; Touvie Wolk, National Liberal Club, Whitehall Place, S.W.1, engineer. The first directors are: Samuel Landman, Touvie Wolk, David Carruthers, junr., Harkishen Lal and Adolf Marcuse. Solicitor: S. Landman, Sentinel House, Southampton Row, W.C.1. No notice of situation of registered office was filed at the time of incorporation.

Pettigrew and Merriman (Continental), Ltd. (197,010).—Private company. Registered April 4th. Capital, £3,000 in £1 shares. To act as sole selling agents of Pettigrew and Merriman, Ltd., of London and Brunet et Cie., of Paris, for all articles manufactured by them, in all parts of the world (except the British Empire), and to carry on the business of manufacturers of and dealers in wireless apparatus and instruments of all kinds, mechanical and electrical engineers, instrument makers, electricians, manufacturers of plant, apparatus, instruments and machinery of all kinds appertaining to electrical and mechanical engineering, including automatic telephone, fire alarm, clock, signalling, wireless and telephone systems, &c. The first directors are:—T. Pettigrew, 31, Little Heath, Charlton, S.E.7; E. Merriman, Stanley House, Pitsea, Essex (both directors of Pettigrew and Merriman, Ltd.); O. Brunet, 95, Avenue Mozart, Paris; P. Brunet, 95, Avenue Mozart, Paris (both directors of Brunet et Cie., Paris). Remuneration as fixed by the company. Secretary: S. H. Goodger. Solicitors: Beaumont, Son and Rigden, 33, Chancery Lane, W.C.2. Registered office: 122 and 124, Tooley Street, S.E.1.

Macfarlane Electrical Co., Ltd. (197,039).—Private company. Registered April 5th. Capital, £3,000 in £1 shares. To acquire the business of electrical engineers, carried on by the Macfarlane Electrical Co. at 83, Camberwell Road, S.E. The first directors are:—R. Brown, "Rosegarth," Gerrards Cross, Bucks.; R. S. Brown, "Rosegarth," Gerrards Cross, Bucks.; W. A. Williams, 9, Castellain Road, Maida Vale, W.9. The said R. Brown shall be permanent so long as he holds 100 ordinary shares. Solicitors: Collyer, Davis and Webb, 91, Moorgate, E.C. Registered office: 83, Camberwell Road, S.E.

Trades Appliances, Ltd. (197,043).—Private company. Registered April 5th. Capital £100 in £1 shares. To carry on the business of manufacturers of and dealers in all kinds of dynamos, electric motors, batteries, electric lamps, electric lighting sets and starting sets, &c. The first directors are:—H. J. Selby, 931a, Abbeydale Road, Sheffield; Mrs. L. Selby, 931a, Abbeydale Road, Sheffield. Solicitors: Hepworth and Chadwick, 14, Butts Court, Leeds.

Groome & Co., Ltd. (197,084).—Private company. Registered April 7th. Capital, £200 in £1 shares. To carry on the business of manufacturers of and dealers in chemical compounds, metals, and mineral ores, and manufacturers of and dealers in mineral ores and other substances used as crystal detectors for wireless receiving sets, &c. The permanent directors are:—J. A. Groome, 17, Windsor Road, Willesden Green, N.W.2, electrical engineer; E. Moss, 56, Victoria Road, Brondesbury, N.W.6, secretary. Qualification: £100 shares. Remuneration as fixed by the company. Secretary: E. Moss. Solicitor: S. Teff, Bank Chambers, 232-238, Bishopsgate, E.C.2. Registered office: 122, High Road, Kilburn, N.W.6.

Sparkes Electrical Co., Ltd. (197,015).—Private company. Registered April 4th. Capital, £400 in £1 shares. To adopt an agreement with H. E. Winn and Maude Pye for the acquisition of the business referred to therein, and to carry on the business of electrical and wireless engineers, &c. The permanent directors are:—H. E. Winn, 8, Rayleigh Road, W.14, electrical engineer; A. A. Briggs, 67, Edith Road, W.1, electrical engineer; Maude Pye, address not stated. Remuneration as fixed by the board. Secretary: Maude Pye. Solicitor: S. S. Moore, 2, Gray's Inn Place, W.C.1. Registered office: 115, Hammersmith Road, W.14

Radio Corporation of Ireland, Ltd.—Private company. Registered in Dublin April 3rd. Capital, £2,000 in £1 shares. To carry on the business of manufacturers, designers, repairers, and owners of and dealers in wireless telegraphy or telephony apparatus, &c. The first directors are:—D. Frame, Corke Abbey, Bray, Co. Wicklow, ironfounder; H. S. Mills, 27, Pearse Street, Dublin, accountant. Secretary: H. S. Mills. Registered office: 27, Pearse Street (formerly Great Brunswick Street), Dublin.

Twencen Manufacturing Co., Ltd. (197,094).—Private company. Registered April 7th. Capital, £2,000 in £1 shares. To adopt an agreement with the Sterling Telephone and Electric Co., Ltd., to acquire the registered trade mark "Twencen," No. 238,678 in class 8, and to carry on the business of manufacturers of and dealers in kaleidoscopes and designoscopes and all kinds of scientific instruments and appliances, whether for scientific research or for purposes of recreation and pleasure, &c. The subscribers (each with one share) are:—C. E. Sherwood, 1, Tanza Road, Hampstead, N.W., company secretary; A. J. Gale, 20, Wroxton Road, Peckham, S.E.15, accountant. The subscribers are to appoint the first directors. Remuneration as fixed by the company. Solicitors: Steadman, Van Praagh and Gaylor, 4, Old Burlington Street, W.1. Registered office: 114-115, Tottenham Court Road, W.1.

Mitchell & Ashdown, Ltd. (196,975).—Private company. Registered April 3rd. Capital, £100 in 1s. shares. To carry on the business of electrical, mechanical and general engineers, manufacturers and agents, &c. The first directors are:—R. A. Mitchell, 129, Kingsland Road, E.2, electrical engineer; H. Ashdown, 17, Commodore Street, Stepney, E.1, electrical engineer. Qualification, 100 shares.

Simmonds & Stokes, Ltd. (196,811).—Private company. Registered March 28th. Capital, £10,000 in £1 shares. To acquire (1) the licence to work the patents of H. Stokes for the Niphan system of couplings for electric cables and portable light and power installations, granted to him in Great Britain, the U.S.A., Canada, Australia, India, Italy, Belgium, France, and Japan, and certain British registered designs; and (2) the electrical business of Simmonds Brothers, Ltd., of 4, 6 and 8, Newton Street, High Holborn, W.C., and of 310, Merton Road, Wandsworth, in connection with the working and their interests in the working and development of the said patents, together with certain assets of the business. The first directors are:—W. F. Simmonds, 18, Christchurch Road, Streatham Hill, S.W., secretary; H. Stokes, 27, Pleydell Avenue, Chiswick, W.4, electrical engineer (managing director); B. S. Simmonds, 58, Wimpole Street, W.1, consulting surgeon (chairman); F. W. Mellows, 78, Woodcote Road, Wallington, Surrey, solicitor. Qualification, 100 shares. Secretary, W. F. Simmonds. Solicitors: Mellows and Mellows, 27 and 28, King William Street, E.C.4. Registered office: Avenue Chambers, Southampton Row, W.C.

Official Returns of Electrical Companies.

Electrico, Ltd.—Particulars filed on April 3rd, 1924, of £3,000 debentures authorised July 6th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being, £2,150.

Rudolph Charles and Goff, Ltd.—Debenture dated March 29th, 1924, to secure £400, charged on the company's property, present and future, including uncalled capital but excluding real estate. Holder: L. Randall, Park House, London Road, Romford.

Whitfield Electrical Co., Ltd.—Debenture dated March 17th, 1924, to secure £2,000 charged on the company's property, present and future, including uncalled capital. Holder: Capt. A. C. Bedworth, Feldenhurst, Boxmoor, Herts.

Cutting Bros., Ltd.—Particulars filed of £12,000 debentures authorised March 17th, 1924, charged on the company's undertaking and property, present and future, including uncalled capital; the whole amount being now issued.

G. H. Turner & Co., Ltd.—P. M. Harper, A.S.A.A., of 329, High Holborn, W.C.1, was appointed receiver on March 29th, 1924, under powers contained in first and second debentures dated November 6th, 1912, and March 24th, 1915.

G. A. Turner, of 101, High Street, Harlesden, ceased to act as receiver or manager on March 29th, 1924.

Whittaker Bros., Ltd. (67,858).—Return dated December 31st, 1923. Capital, £7,000 in £1 shares. 3,907 shares taken up. £3,207 paid. £700 considered as paid. Mortgages and charges, nil.

Montreal Tramways and Power Co., Ltd.—Satisfaction in full on March 1st, 1924, by redemption, of 5-year 6½ per cent. secured gold bonds covered by trust deed dated February 15th, 1919, securing $7,300,000 (or £1,500,205 10s.).

Westminster Electric Supply Corporation, Ltd. (27,061).—Return dated March 12th, 1924. Capital, £2,000,000 in 200,000 ordinary and 300,000 4½ per cent. preference shares of £5 each. 151,124 ordinary and 110,000 preference shares taken up. £1,305,620 paid. Mortgages and charges, nil.

Drake & Gorham, Ltd. (70,275).—Return dated October 19th, 1923. Capital, £125,000 in £1 shares. All shares taken up. £85,000 paid. £40,000 considered as paid. Mortgages and charges, £12,000.

City Notes.

Metropolitan-Vickers Electrical Co., Ltd.

The annual meeting was held on April 9th at Central Buildings, Westminster, Major-General Sir Philip A. M. Nash presiding. In moving the adoption of the report, the chairman, after referring with regret to the loss which the company had sustained in the death of Mr. Annan Bryce, who held the office of chairman for 14 years, prior to resigning the position in 1922, turned to the accounts, and said that the item of works, machinery, plant, &c., £1,157,525, showed an increase of £46,678, due to certain improvements in the shops at Trafford Park, necessitated by the providing for increased efficiency in their testing departments and other required developments. Stock and materials on hand, £1,724,040, showed a substantial increase of £267,550. Coming to the profit and loss account, no doubt the result showing gross profits amounting to £229,216 against £324,835 last year would be a disappointment to the ordinary shareholders, as the balance available was only £140,963. Adding to that the balance brought in from last year, £105,310, gave them the sum of £246,273, which was appropriated as follows: £15,000 to general reserve, to carry forward £85,518, leaving a balance of £145,755 for the payment of dividends of 8 per cent. on both the preference and ordinary shares. The year 1923 was one of great difficulty for the electrical industry. The total manufacturing capacity for electrical apparatus in the United Kingdom to-day was very considerably in excess of that which existed in 1914, whereas the volume of work placed in 1923, as also in 1922, had been wholly insufficient to allow normal utilisation of that capacity. Whilst the electrical industry did not suffer from the general depression in trade as severely or as early as other important industries, it was inevitable that a time would come when it had to experience the same slump as other industries on which it was depending for a substantial amount of business. That time arrived early in 1923, and adversely affected the results of the company. That was particularly noticeable in what might be termed the "bread and butter" products of the company, namely, the smaller types of apparatus, the demand for which afforded a good barometer of trade. The year 1924 commenced with a volume of work in hand at about the same level as in 1923, and it was satisfactory to report that since the beginning of this year the company had obtained new orders considerably in excess of those taken in the corresponding period of last year. In the aggregate a higher percentage of the company's productive capacity was being utilised to-day than at any time during 1923. That was a very good feature and provided there was no enforced interruption during the year in manufacture, the prospects for an increased output were good. The number of inquiries for new plant was being well maintained, and therefore from the point of view of volume of work, the position was considerably better than a year ago. Last year he alluded to the possible increase in business from railway traction. He was glad to say that his hopes in that direction had been realised, and the company was now fulfilling important contracts for home railways in that class of work. He also described the organisations which they had in existence abroad for handling their work. He was glad to be able to tell them that the work of those foreign offices resulted in an increase in the volume of general business from abroad for 1923 as compared with 1922. He regretted, however, to have to say that the prices obtained were on the whole on a lower level of profit, due no doubt partly to the efforts being made by all electrical concerns in this country to fill the vacancies in their factories which resulted from the severe slump in business commencing in 1922 and continued throughout 1923. Another powerful factor in the reduction of prices received in their export territories arose from the severe competition which had to be met from countries whose internal markets were protected by tariffs, or who could operate with exchanges in their favour. Those competitors were able, by virtue of the prices received in their home markets, to absorb in their home business, even in times of relatively slack trade, the whole of their standing charges, with the result that they could offer their products abroad at any price obtainable above labour and material, as the excess price over the cost of these two items represented in that case an additional profit to them. Our home market was an export market to them, and they could afford, on the basis indicated, to offer to English buyers apparatus such as the company manufactured at prices totally unremunerative from their point of view. While the patriotism of British buyers had in most cases led them to buy in England, even when the prices were higher than foreign competition, and while the volume of electrical business placed abroad had not been, he was glad to say, very considerable, the net result of the continuous reception by their clients here of those low prices from abroad had forced the price of products, even in the home market, down to a level when there was very little margin above the true cost of the apparatus. The result was not only a reduction in the profits obtainable on the home business, but it did not leave the margin available to enable them to fight as effectively as they should the competition of the protected countries in the export market. As the company depended for at least half its business on those export markets it was clear that unless there was to be a large percentage of unemployment in the industry some means must be found for maintaining their exports. That could only be done, in view of the circumstances which obtained in world competition, by securing remunerative prices at home; without those the industry could not compete abroad as it should and it could not, therefore, employ the volume of labour otherwise possible. The question, therefore, of security for the electrical industry which would enable it to obtain remunerative prices at home was as much one for labour as for capital. That was not the place to enter into a discussion on the merits or demerits of Protection as a policy for the country, but the facts of the situation as affecting the electrical engineering industry were as he had given, and they merited the most serious and careful consideration of the Government, of the employers, and of the employed, all of whom were equally interested in a solution of the problem of how to keep the industry prosperous, and to employ the maximum number of men. Before leaving the subject of their export trade, he would like to draw attention to some large contracts which they had taken for Russia. Those had been accepted

by them without being able to utilise the export credits scheme or the Trades Facilities Act. The board felt that they had practically reached the limit of business which they would be justified in accepting at their own risk under the present conditions obtaining in Russia. On the other hand, there was a large amount of business offering of a desirable nature from every point of view except the financial one, and they felt that a natural corollary to the official recognition of the Soviet Government by the British Government would be an extension to Russia of the Trades Facilities Act, or some other scheme of a similar nature, which, provided a concern like their own had already shown its *bona-fides* by accepting a certain amount of business at its own risk, would enable it to take at least an equal amount of business under some financial guarantee provided by the Government. That Russian situation was one which they thought should receive from the Government the most careful consideration, along some such lines as he had indicated. Provided the financial situation involved could be adequately dealt with there was a large amount of business which would come to this country which would benefit their industry and contribute materially to the relief of unemployment. Conditions were at the moment more promising for trade prosperity in most of their principal export markets; for instance, in India, where the favourable balance of trade had increased compared with 1922; similarly in Australia and South Africa, and in South America, where exchange was rising. Those conditions should mean that more money would be available in 1924 in those countries than in 1923, but other movements were, however, operating against that forecast. Wholesale prices in Britain were inclined to rise, whilst for purposes of comparison, in terms of a gold basis, they were falling in the United States of America, Sweden, and Switzerland. That meant that their materials would begin to cost too much in comparison with materials in those competitive countries, and that higher productive costs might weaken further their position in the markets of the world. He thought, therefore, that it would be incorrect to state that the improved economic condition of those markets mentioned was sufficient to justify an increase in the price of British goods exported to them. The markets of the world were now probably in a position to absorb more in 1924 than they absorbed in 1923 if prices could be kept at approximately their present level, but if prices rose appreciably trade would be deflected to their competitors abroad. Those remarks on the prospects of future business were not complete without reference to the labour situation. The position generally in the country showed a growing restlessness which had extended to their own industry. Applications for increased wages affecting the company were now before the Engineering Employers' Federation, on which they were represented, and in the circumstances it was not prudent for him to do more than he had already done in setting forth the handicap which the British electrical industry had to submit to under present conditions in meeting world's competition at a time when there were indications of improvement in industrial activity. The occasion was, in his opinion, one on which the workers and employers should put their heads together, to ascertain whether increased wages could be granted, and at the same time the cost of production be safeguarded from advancement.—Mr. Alex. Spencer, vice-chairman, seconded the motion, which was unanimously adopted without discussion.

Bath Electric Tramways, Ltd.

Addressing the shareholders at the annual meeting on April 10th, Mr. J. B. Hamilton, C.B.E., said that although the revenue had decreased in 1923, there was a larger net surplus. Referring to the payment of a dividend on the preferred ordinary shares, the chairman said that this could have been done in any of the last three or four years, but to have paid a dividend one year and have been obliged to pass it for, perhaps, several years, would have affected the stability of the company. It was hoped that the company would be permitted to continue the present fares for a longer period; permission had already been obtained to continue them until the end of the present year. The contingencies and renewal account might seem large, but having regard to the probable requirements for the purpose of track renewals—and some of the track was 21 years old—the directors did not consider it at all too large.

West London and Provincial Electric Supply Co., Ltd.

The annual meeting was held on April 9th, Mr. Harry Kahn (chairman) presiding. The whole of the company's income is derived from the Chiswick Electricity Supply Corporation, Ltd., of which it is the sole shareholder. The Chiswick Corporation's accounts were abstracted in our last issue (p. 587). Mr. Kahn said that the results were very satisfactory both to the shareholders and the consumers, who had benefited by price reductions. The Chiswick Supply Corporation had found that a bulk supply from Hammersmith cost just as much as energy generated in its own station, so that there was no intention at present of displacing the generating plant. At the Aberystwith station the substitution of Diesel engines for the steam plant had resulted in great economies. It was possible that in the future a bulk supply would be available from the North Wales Power Co., but when that time came it would be necessary for the company to consider whether it would not be better to extend its own generating plant rather than to take such a supply. In conclusion, the chairman proposed the payment of dividends and interest, including 4½ per cent. on the ordinary shares. A balance of £3,009 is to be applied to the redemption of funding certificates.

The Brush Electrical Engineering Co., Ltd.

The report for the year ended December 31st, 1923, states that the profit and loss account shows that after providing for general charges, maintenance of plant and buildings, and interest on the company's debenture stocks, &c., there remains a balance of £94,860, making, with £103,819 brought forward, a total balance of £198,678, subject to Corporation Profits Tax for 1923. There has been allocated to depreciation of buildings and plant £15,000; to further 4 per cent. interest on the prior lien participating second debenture stock, £2,044; to income tax, 1923-24, £33,618; and to general reserve, £23,635, leaving £74,297. It is recommended that a dividend at the rate of 10 per cent. per annum on the ordinary shares be paid, absorbing £45,856, leaving £78,525 to be carried forward. The general reserve account has been increased by £1,365, profit on purchase of the company's debenture stocks for sinking fund purposes. The further £23,635, now appropriated to this account, raises the general reserve fund to £225,000. £13,664 has been expended on capital account during the year. The year's operations have been marked by continuous depression of trade and severity of competition in both home and foreign markets. The demand for Brush-Ljungstrom turbo-alternators and other specialities of the company has continued satisfactorily, and the works have been well employed during the past year, but owing to foreign and general competition for orders the prices obtained have been lower than in recent years. Owing to ill-health Mr. W. L. Madgen has resigned his seat on the board. Mr. F. R. Davenport and Mr. W. Johnstone have been appointed directors. Meeting: Monday, April 28th, in London.

London Electric Wire Co. and Smiths, Ltd.

Sir George H. Fisher-Smith (chairman) presided at the annual meeting on April 9th. In moving the adoption of the report and accounts, which were summarised in our last issue (p. 587), the chairman said that in view of the existing uncertainties it had been thought desirable to provide a special contingency reserve from which dividends could be paid if the business was affected by trade disturbances or other circumstances beyond the directors' control. The improvement in the profit was due to a greatly-increased output, mostly at cut prices. It was a sound policy to adopt low selling prices in order to stimulate trade, and it was of special benefit in export business where tariffs had to be contended with. Among the factors which adversely affected trade were the Ruhr situation and high taxation.

With regard to the electrical trade, in which the company was concerned, they had every reason for optimism; that industry had splendid prospects, and the company would no doubt obtain its proportionate share. If trade disputes were avoided the future could be looked forward to with every confidence. The orders in hand were in excess of those upon the books a year ago, and the company was capable of dealing with still larger demands.

Madras Electric Tramways (1904), Ltd.

The gross profit for 1923 was £37,603, and after meeting interest and London office expenses, making provision for the debenture stock sinking fund, and transferring £10,000 to depreciation and renewal account, there remains a balance of £18,300. To this are added a balance of £7,538 brought forward, and £2,026, excess provision for taxation, making £27,684. After meeting the preference dividends, a distribution of 8 per cent., together with a bonus of 2½ per cent. (both free of tax), is recommended on the ordinary shares. Of the balance, £1,750 is to be allocated to debenture stock redemption, £5,000 transferred to general reserve, and £7,239 carried forward. The traffic receipts, in rupees, show an increase of 8.7 per cent., while the running expenses were reduced by 4.9 per cent. The negotiations with the Government and the Corporation of Madras have not yet been completed; the Corporation, however, has expressed its willingness to abolish track rent entirely, and it is hoped that terms and conditions which will justify the construction of the extensions will soon be arranged. The outstanding 5 per cent. mortgage debenture stock of the company is to be redeemed, and a new and larger issue made. Meeting: May 7th.

Belgian Companies.

The *Compagnie des Tramways et Electricité* reports that the improvement in the transport undertakings continued in 1923, but the net profits, which were only 103,000 fr., have had to be carried forward.

The *Compagnie Générale de Railways et d'Electricité* records net profits of 6,650,000 fr. for 1923 as compared with 4,496,000 fr. in the preceding year. It is proposed to pay a dividend at the rate of 7 per cent. on the ordinary shares as against 6 per cent. in 1922.

The *Ateliers de Constructions Electriques de Charleroi* after writing off 1,200,000 fr. for depreciation, reports net profits of 5,303,000 fr. for 1923. This result compares with a provision of 1,000,000 fr. for depreciation and net profits of 5,314,000 fr. in 1922. The rate of dividend is 6 per cent., the same as for 1922.

The *Société de l'Electricité de Seraing et Extensions* reports a net profit of 2,913,588 fr. for the last financial year, as compared with only 2,584,705 fr. in 1922. The capital of the undertaking is 12 million fr.

La Société des Tramways Electriques en Espagne reports a loss of 204.575 fr. for the past year, as compared with a profit of 10,280 fr. in 1922. The capital of the undertaking is 20 million fr.

French Companies.

The report of the *Société d'Electricité de Limoges* for last year shows a net profit of 940,000 fr. as compared with only 748,000 fr. in 1922.

The *Société de Forces Motrices de la Vienne* is increasing its capital with the object of completing its constructional programme. Among the work contemplated is the completion of the hydro-electric station at Chardes and the installation of a 2,000-h.p. steam turbine and alternator.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Bournemouth and Poole Electricity Supply Co.—60,000 ordinary shares of £1 each, fully paid (Nos. 550,001 to 610,000).

Oriental Telephone and Electric Co.—2,695 ordinary shares of £1 each, fully paid (Nos. 426,147 to 428,841); and 1,945 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 186,697 to 188,641).

Application has been made to the Committee to allow the following to be officially quoted:—

Traction and Power Securities Co.—£256,230 ordinary stock and £427,050 5 per cent. cumulative preference stock.

The undermentioned have been ordered to be officially quoted:—

London Electric Supply Corporation.—499,500 ordinary shares of £1 each, fully paid (Nos. 1 to 499,500).

Windermere and District Electricity Supply Co., Ltd.—The gross revenue during 1923 increased by £1,195 to £10,423, and the working expenses fell from £6,114 to £5,871. The total available balance, including £567 brought forward, is £5,507. Out of this are defrayed debenture interest, contribution to depreciation and reserve funds (£1,000 and £500), &c. The preference dividend is to be paid and a balance of £541 carried forward. A new engine room has been erected to accommodate a 250-h.p. Diesel engine.

National Electric Construction Co., Ltd.—The report for the year 1923 shows a profit of £17,016. The net balance, after deducting debenture interest and sinking fund premium, and adding £4,249 brought forward, was £15,965. It is proposed to dispose of this as follows:—Depreciation, £334; reserve and renewals, £2,000; reserve for equalisation of dividends, £1,000; general reserve, £3,000; dividend of 8 per cent., less tax, £5,227; carrying forward, £4,404. The report states that the progress of the tramways and electricity supply undertakings in which the company is interested has again been satisfactory.

German Company.—*Transradio Akt. Ges. für Drahtlosen Ubersee-Verkehr.*—The report for 1923 states that the capital was increased during the year from 50 to 110 million marks. The figures of the accounts, in view of the depreciated exchange, are so enormous that difficulty is caused in assessing them at proper values. The total receipts were 444,715 million million marks. The profit was 129,685 million million marks, including 2,097,361 marks brought forward.

Prospectus.—*Madras Electric Tramways (1904), Ltd.*—The list was opened on Tuesday and was to close on or before yesterday, Thursday, in an issue of £130,000 5½ per cent. (registered) debentures (£100 each). The object of the issue is to provide capital for extensions and to redeem the balance of the debenture stock now outstanding (£50,940).

Pernambuco Tramways & Power Co., Ltd.—The net receipts for 1923 amounted to £102,836, but after deducting interest and discount charges, and £1,500 for amortisation fund, there was a deficit of £6,309. This is added to a debtor balance of £17,573, making a total of £23,882. The gross earnings showed an increase of 25 per cent. or more.

Italian Company.—The Terni Co., which recently absorbed the Vickers Terni Co. and the Societa Carburo di Calcio, has decided to increase its capital from 200 million to 350 million lire, principally for the purpose of developing its hydro-electric properties in Italy.

Montevideo Telephone Co., Ltd.—A dividend at the rate of 4 per cent. (payable May 1st) has been declared upon the ordinary shares for the half-year ended January 31st.

Indo-European Telegraph Co., Ltd.—The directors recommend a final dividend of £1 2s. 6d. on the ordinary shares (free of tax), making 7 per cent. (free of tax) for the year 1923.

Keswick Electric Light Co., Ltd.—The net revenue for 1923 was £2,085, and after the payment of debenture interest, contributions to reserve, &c., there remains a balance of £1,796.

Anglo-American Telegraph Co.—Interim dividend for the quarter ended March 31st of 15s. per cent. on the ordinary stock, less tax, payable May 1st.

Electrical Utilities, Ltd.—Dividend of 1¼ per cent. on the preferred stock for the quarter ended March 31st, 1924, payable April 15th.

Stocks and Shares.

MONDAY EVENING.

THE influence of the coming Easter holidays makes itself felt to a tolerable extent over Stock Exchange markets, but business has been erratic for some time past and continues to be so, though, of course, with each succeeding day this week, the volume will become more contracted. The feature is the manner in which all investment securities hold their prices. No doubt can be entertained as to the usefulness of the service performed by the Government to the Stock Exchange in offering to the 5 per cent. War Loan proprietors the option of converting into a 4½ per cent. stock. This has created a feeling in the minds of the War Loan holders that, even though they may not convert, it is possible that they ought to do something with their stock in order to render it more productive than it is at present, having regard to the shortness of the probable life of the loan.

For this reason, attention is being turned to debenture stocks, sound preference shares, and, in a minor degree, to the good-class ordinary shares. Electricity supply issues are all very firm. Districts and Metropolitan Consolidated keep strong, in the Home Railway group; the re-opening of part of the City and South London Tube acts as an oblique advertisement to this section. Debenture and preference stocks are a point or two higher.

Mention of debenture stocks renders it appropriate to catalogue some of the electric supply and traction issues now obtainable in the market. There is not, in point of fact, a wide selection, but the following stocks are on offer at the time that this is being written:—

Debenture.	Interest per cent.	Price.	Yield. £ s. d.	Interest payable.
Anglo-Arg. Tram.	6	74½	6 14 0	J. & D.
British Columbia Elec. ...	5	102½	4 17 0	F. & A.
	tax free		net	
Fife Tram., Light & Power	5	96	5 4 0	M. & N.
London & Suburban Trac. ...	4½	61	7 7 6	J. & J.
Metropolitan-Vickers	4	76½	5 4 6	J. & J.
Rangoon Elec. Trams. ...	5	90	5 11 0	J. & J.
South Wales Elec. Power ...	5	72	6 19 0	J. & J.
Urban Elec. Supply	6½	102	5 8 0	J. & D.
Vancouver Power	4½	70½	5 7 0	J. & J.
Whitehall Electric Invest. ...	6	95½xd	6 5 6	A. & O.

Further particulars will no doubt be sought from their brokers by prospective investors who think of putting money into any of these securities. Space does not permit of a detailed account of each stock, but the generalisation may be repeated that the higher the yield, the greater the risk.

Madras Electric Tramways (1904), Ltd., has issued its expected £130,000 5½ per cent. registered debentures at 93, and the Egham and Staines Electric preference shares were offered last week to shareholders in the company. The new shares in the Bournemouth and Poole Electricity Supply Company stand at 2s. 6d. premium with 26s. paid. Several new issues are expected to be forthcoming in this market before long, though the intervention of Easter is likely to prove a restraint upon this branch of finance. Edmundsons ordinary have risen to 4¼ and Urban preference at 20s. are up 1/16. Apart from these, there are no other changes to be recorded in the market for home electricity supply shares. The influence of politics over this market is beginning to be manifest, by the way in which purchasers are not quite so eager as was the case a little time ago. The manufacturing shares are also quiet. General Electrics at 20s. 6d. show a trifling decline, though the preference remain firm at 23s. 6d. Babcock and Wilcox found supporters at 46s. 3d., the nominal middle price.

Brazilian Tractions have lost the 1¼ points which they gained a week ago, the price receding to 57¼. Mexican Light and Power common and preferred shares are lower, on account of the disappointment felt at the absence of any notification, up to the present, of a cash payment upon Mexican Government coupons, due, according to expectation, on the Tuesday in this week.

Marconis have given way to 1⅞, at which price there are sellers, and the preference moved down to 1 7/16. The company's 6½ per cent. debentures fell 10s. to 99 by reason of the dulness apparent in the ordinary shares. Canadian Marconis weakened to 4s. 9d. and the wireless group as a whole is somewhat depressed, the reason being, naturally, the continued lack of any dividend announcement on Marconi parent shares, up to the present, in respect of 1923. The Eastern group is better, with rises in Eastern ordinary, Globes and Westerns. Great Northerns advanced to 28. Callenders, Henleys, and British Insulated remain at the common price of 48s. 9d. and India Rubber shares at 15s. The rubber share market is languid and inert.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom. £	Dividend. 1922.	Dividend. 1923.	Price April 14, 1924.	Rise or fall.	Yield. p.c.
Brompton Ordinary	1	12	10	37/-	—	*£5 8 1
Charing Cross Ordinary	1	14	14½	44/6	—	6 11 0
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6 0
Chelsea	1	10	12	15	—	6 8 0
City of London	1	15	15	47/-	—	6 7 8
do. do. 6 % Pref. ...	1	6	6	23/6	—	5 2 2
County of London	1	10	15	47/-	—	6 7 8
do. do. 6 % Pref. ...	1	6	6	1½	—	5 6 8
Edmundson's Ordinary	3	7	7	4½	+ ¼	4 14 0
do. 6 % Pref.	5	6	6	5½	—	5 17 1
Kensington Ordinary	—	12	14	10½	—	6 13 4
London Electric	3	10	10	4¾	—	6 7 5
do. do. 6 % Pref. ...	5	6	6	5¾	—	5 11 7
Metropolitan	1	8½	10	1 1/2	—	5 1 4
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	2½	6	19/6	—	6 3 1
do. 5 % Pref. ...	1	5	5	16/9	—	5 19 5
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	—	—	1	—	Nil.
do 6 % Pref. ...	1	5	6	1	+ 1/2	6 0 0
St. James' and Pall Mall ...	5	14½	17½	13½	—	6 13 4
South London	1	11	15	42/3	—	6 18 10
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Westminster Ordinary	5	12	15	10¾	—	6 19 6
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	20/6	—	7 6 4

Home Rails.

Central London Ord. Assented	Stock	4	4	68½	—	5 16 10
Metropolitan	,,	3½	4	73	—	5 2 7
do. District	,,	3	3½	52	+ ½	6 13 4
Underground Electric Ordinary	10	Nil	Nil	2⅜	— ⅛	Nil
do. do. "A" ...	1	Nil	Nil	7/6	—6d.	Nil
do. do. Income Bonds	5	6		97	—	*6 3 9

Telegraphs and Telephones.

		Dividend. 1921	Dividend. 1922			
Anglo-Am. Tel. Pref.	Stock	6	6	102	—	5 17 9
do. Def.	,,	1½	34/6	22⅜	+ ¼	6 12 4
Chile Telephone	5	6	6	6½	—	4 18 0
Cuba Sub. Ord.	10	7	7	7½	—	9 13 2
Eastern Extension... ...	10	10	10	17	—	5 17 8
Eastern Tel. Ord.	Stock	10	10	172½	+2	5 16 0
Globe Tel. and T. Ord. ...	10	10	10	17⅞	+ ¼	5 12 8
do. do. Pref. ...	10	6	6	10⅜	—	5 11 7
Great Northern Tel. ...	10	24	22	28	+ ¼	7 17 2
Indo-European	25	10	7	32½	—	*5 7 8
Marconi	1	25	15	1⅜	— 1/16	9 4 8
Oriental Telephone Ord....	1	12	12	12	—	*6 17 2
United R. Plate Tel.	5	8	8	6⅝	—	*5 16 6
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	16⅝	+ ⅛	5 18 5

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	12½	8½	—	8 9 0
do. do. 2nd Pref. ...	5	Nil	5½	2⅛	—	10 4 4
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16 3
British Electric Traction Ord. ...	,,	4½	5	74	—	6 15 3
do. do. 6% Pref. ...	,,	6	6	99½	—	6 0 6
Brazil Traction	100	Nil	4	57½	—1½	6 19 2
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	83½	—	5 19 9
do. do. Preferred	,,	5	96/-	83½	—	*5 15 0
do. do. Deferred	,,	8	127/-	101½	—	*6 8 2
do. do. Deb.	,,	4½	4½	78½	—	5 8 3
Lond. & Sub. Trac. 6 % Pref. ...	1	8½	5	6/-	—	8 6 8
London United Tram. Deb. ...	Stock	4	4	£0	--	8 0 0
Mexico Trams. 5% Bonds ...	—	Nil	Nil	73½	—	6 16 0
do. 6% Bonds ...	—	Nil	Nil	50½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—1	Nil
do. Pref.	100	Nil	Nil	46½	—1	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6 0

Manufacturing Companies.

Babcock & Wilcox...	1	15	20	46/3	—	*4 6 2
British Aluminium Ord....	1	10	5	23/3	—	4 5 10
British Insulated Ord. ...	1	15	15	2⅞	—	6 3 0
Callenders	1	15	15	48/9	—	6 3 0
do. 6½ Pref.... ...	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅞	—	8 17 10
Edison-Swan	4/-	10	Nil	4/9	—	6 6 4
do. ,, 5% Deb.	Stock	5	5	77½	—	6 9 0
Electric Construction	1	10	10	1⅝	—	6 7 5
English Electric	1	8	5	17/6	—	5 14 3
do. do. Pref.	1	6	6	19/-	—	6 6 4
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	10	5	20/6	—6d.	4 17 7
Henley	1	15	15	2⅛	—	6 3 0
do. 4½ Pref.	5	4½	4½	4½	—	5 9 1
India-Rubber	1	10	1⅟	⅔	—	*6 13 4
Met.-Vickers Pref....	2	8	8	2⅛	—	6 5 0
Siemens Ord.	1	10	10	16/3	—	Nil
Telegraph Con.	12	20	20	24	—	*5 0 0

* Dividends paid free of Income Tax

Market Quotations for Chemicals and Metals.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.		Price April 15.	Fortnight's Inc. or dec.
a Acid, Oxalic	per lb.	5¾d.	...
a Ammoniac, Sal	per ton	£60	...
a Ammonia, Muriate (large crystal)	,,	£52	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£25	...
a Copper Sulphate	,,	£25 10s.	...
a Potash, Chlorate	per lb.	4d. to 4½d.	...
a ,, Perchlorate	,,	4½d.	...
a Shellac	per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ...	,,	£7 15s.	...
a ,, Roll	,,	£7 15s.	...
a Soda, Chlorate	per lb.	3d.	...
a ,, Crystals	per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ...	per lb.	4½d.	...
METALS, &c.			
b Aluminium, Ingots	per ton	£120 to £125	...
b ,, Wire	per lb.	1/9 to 2/6*	...
b ,, Sheet	,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—			...
Grade I	per ton net	£230	£10 dec.
Grade II ... ... ,, ,,		£164	£8 dec.
Grade III ... ... ,, ,,		£90	£6 dec.
c Brass (rolled metal 2" to 12" basis)	per lb.	10¼d.	¼d. dec.
c ,, Tubes (solid drawn) ...	,,	1/0½d. to 1/0¾d.	...
c ,, Wire, basis	,,	10¾d.	¼d. dec.
c Copper Tubes (solid drawn) ...	,,	1/1¾d.	...
c ,, Bars (best selected) ...	per ton	£98	...
c ,, Sheet	,,	£98	...
c ,, Rod	,,	£98	...
d ,, (Electrolytic) Bars ...	,,	£70 10s.	15/- dec.
d ,, ,, Sheets ...	,,	£145 10s.	...
d ,, ,, Wire Rods ...	,,	£80 10s.	15/- dec.
d ,, ,, H.C. Wire	per lb.	10¼d.	¼d. dec.
f Ebonite Rod	,,	2/- to 3/6	...
f ,, Sheet	,,	2/- to 3/6	...
n German Silver Wire	,,	2/3	...
h Gutta-percha, fine	,,	8/6	...
h India-rubber, Para fine	,,	11½d.	¾d. dec.
Iron Pig (Cleveland Warrants) ...	per ton.	£5 2s. to £5 2s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£25	...
g Lead, English Pig	,,	£32 15s.	£3 dec.
g Mercury	per bot.	£14	£1 inc.
e Mica (in original cases) small ...	per lb.	3d. to 3/-	...
e ,, ,, medium	,,	4/- to 8/-	...
e ,, ,, large ...	,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings	,,	1/3½	...
p ,, ,, drawn bars & rods	,,	1/4	...
p ,, ,, rolled strip & sheet	,,	1/3½	...
p ,, ,, wire	,,	1/4½	...
o Platinum	per oz.	£25	...
d Silicium Bronze Wire	per lb.	1/0½	...
r Steel, Magnet, in bars	,,	10d.	...
n Tin, Block (English)	per ton.	£244 to £244 10s.	£14 to £14 10s. dec.
n ,, Wire, Nos. 1 to 16	per lb.	4/2	...

*For 1 cwt. lots. Special quotations against definite specifications.
Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

The Properties of Dielectrics.—Under this title, Mr. G. L. Addenbrooke wrote to *Nature* of April 5th, giving certain conclusions with regard to dielectrics, based on a long study of the subject. Describing experiments on thin sheets of celluloid, the author showed the very important influence of moisture on the properties of this dielectric; in its normal condition it had a dielectric coefficient of 10 at 8 cycles per second, falling to 6.8 at 200 cycles, but when it was completely dried its coefficient was found to be 4.8 at all frequencies. Moreover, the coefficient so found was practically unaffected by change of temperature. From the experiments, which are detailed, the author infers that if the small amount of moisture remaining in the dielectric could have been extracted, "no alternating loss or dielectric hysteresis would have remained; that the ordinary resistance would have been substantially infinite; finally, that the capacity would be the same at all ordinary frequencies and characteristic of the substance." These experiments and views were put forward in Mr. Addenbrooke's lectures at the Institution of Electrical Engineers in 1919, but have not otherwise been published; he is extending the work and putting the results into book form.

Fire.—There was an outbreak of fire, on April 10th, at 21-23, Farringdon Road, E.C., the premises of Messrs. J. & W. B. Smith, Ltd., gas and electrical fitting manufacturers. The official report of the London Fire Brigade states: "It is a building of seven floors, about 80 ft. by 35 ft., used as workrooms, showrooms, offices, and stores, and it had the five upper floors and the contents severely damaged by fire, a part of the roof was destroyed, and the rest of the building and contents were damaged by heat, smoke, water, and breakage. Adjoining premises were also damaged by water.

Some Ill-considered Aspects of Trading Agreements.

By "JUST BIDE A WEE."

Much interest has been aroused of late in respect of various schemes now being put forward in the electrical and other trades regarding "fair trading," but few really realise their true significance. That such agreements are vital in their effects is not fully appreciated, and it may not be out of place to devote a few moments to their consideration.

In general, most agreements run on the following lines: (*a*) Contracting parties comprise manufacturers, factors and contractors, and these terms are defined.

(*b*) Contracting parties agree to be mutually supporting.

(*c*) It is agreed to restrict cash sales (if not to abolish them) and mutual credit terms are arranged.

(*d*) It is agreed to keep strictly to the quoted schedule after an order is placed.

(*e*) It is agreed to eliminate the middleman except where he carries substantial stocks—also the "no-oncost" man.

(*f*) It is agreed that makers' lists be subject to certain fixed discounts, only to be participated in by the contracting parties.

(*g*) It is stipulated that the contracting parties possess premises with facilities for stock, and have occupied them for not less than a certain time.

(*h*) It is stipulated that contracting parties be financially stable.

(*j*) It is agreed to aim at the reduction of costs, especially with regard to quantity buying among the contracting parties. And so on, with other more or less minor regulations.

At a first reading these various points may create a fairly good impression on the reader's mind, but a few moments' thought will reveal that "there is more in it than meets the eye." It soon becomes apparent that the whole arrangement must be considered from many points of view, chief among which are:—

1. The present condition of the electrical industry.

2. The real, actual distribution of the manufacturer's sales; *i.e.*, in what proportion his orders received are executed among the contracting parties as against among those who are not contracting parties.

3. Is the consumer considered in the true business spirit of service?

4. The possible effect of the arrangement, when concluded, on the relations between employer and employed.

Considering the aforementioned agreement clauses in the light of (1) above, trouble is certain to arise right off in the interpretations of the definitions of the status of the various contracting parties. Practically every manufacturer is at some time a factor and contractor. He is forced to do work other than his own solely on account of the necessity for meeting his client's needs. Thus a motor manufacturer may require to install his client's motor to create a good impression of service with a view to future business, and the more apparent future business appears the more readily does the manufacturer undertake subordinate work. That this is a fact is undoubted. Indeed, it is one of *the* things which generally are the cause of any agreement being entered into. The manufacturer will let the contractor and factor take a back seat rather than lose a valuable customer. Further, the agreement indicates that contractors are painfully aware of this. The same thing holds good with a factor. To meet a customer's needs, the factor will make up, say, a switchboard, or mount a generator on a bedplate with a prime mover, &c., entirely to meet his customer, irrespective of whether his brother, the contractor, objects or not. Further, the contractor is under exactly similar circumstances forced to manufacture small composite items to meet his local needs and to prevent rivals hearing of the job.

There is thus a grave complexity of circumstances existing in point of fact, a complexity which does not offer any chance of simplification. One has only to scan other trade papers to glean sufficient information that trading agreements are merely "scraps of paper," in this respect. All of this is made worse under the present industrial stagnation. It is well known that the manufacturer is not now selling to make a profit, but merely to keep his works going, for, in general, it is the soundest policy at present, to take on work at any price rather than close down. To lose an influential *clientèle*, even in face of serious financial difficulty, is to commit a grave business crime.

Thus it is that status definitions are quite useless, and "mutual support" becomes a mockery.

Then again, grave fault can be found with (*c*). The "5 per cent. discount for cash" seems to be a bugbear to the contractor, but of its usefulness in ordinary business, apart altogether from cases of extremity, there is little doubt. Indeed, it has long since become a recognised thing in practically every trade to offer a discount for prompt cash. The financial debility of some of our larger firms, as evidenced by company meetings, share reports, &c., has further tended to confirm an arrangement which ensures a quick production of ready cash, and come what may, it will appear to most people that much water will flow under Tower Bridge before the cash discount is universally abolished. In brief, it is now an essential. Why should it be cast out? Would it be reasonable to do so? Surely not.

Passing over (*d*) as reasonable and honest, we come right up against another fundamental difficulty: Who and what is a middleman as distinct from a factor or contractor? And who or what is a "no-oncost" man? These are sore, sore points. For years they have been argued about, and still they are trotted out for slaughter. The plain fact is that to most manufacturers the first comer is the customer and the man he wants, irrespective of his status. Can a maker tolerate this kind of thing:—Motors were supplied by a maker to a confectioner, to the instructions of the latter's consulting engineer. Some weeks later a letter was received from a contracting firm stating that as Messrs. ——— "were old customers of ours, we presume you have covered us (figure given)." The makers did not know this, nor could they be expected to know it. In the fact of this kind of thing (many other like cases are on record) is it possible to reach any agreement on the elimination of so-called middlemen or casuals? The writer thinks not, and his contention is supported by the fact that in the light castings trade, especially with respect to baths, &c., the hopelessness of fast and rigid rules in this connection is fully realised, and provision is made in the standard price lists to allow a reduced discount to the "casual" firm or individual (*i.e.*, the man who has no direct connection with the sale, but is nevertheless a member of the trade) as distinct from the regular trade discount to a real acting intermediary (if any). A fuller appreciation of this important arrangement would save endless back-biting and loss of business. It is a simple step to pass on to the consideration of (*f*) and (*g*) referring to discounts. The trouble here is merely an extension of that outlined above. In a nutshell it hangs on "In terms of the agreement, who is in the trade and who is not?".

In general, if a man has no business premises or

merely has an office without a stock- or show-room, or operates from his private residence, or in any other manner avoids heavy oncosts, he is debarred from participating in trade discounts. Is this fair? True, it is possible for a man to compete unfairly in these circumstances, but why debar him from a discount? A reduced discount would meet his case in the sense that it would be the equivalent of adding to his oncost, and so forcing him to quote a reasonably fair figure for any work. Who can deny that the men now trying to "trade fairly" commenced their own businesses in nine cases out of ten in precisely the manner of the man whom they wish to debar from all discount? (The consumer is not here referred to.) No; if an agreement for fair trading is to be fair, then let us have it—fair. It does not generally appear to strike the contracting parties to the agreement that in eliminating the "no-oncost" man they do grievous harm to the industry. The small men of to-day become the big men of the future, just as their predecessors became the big men of to-day, and to deny the process of evolution its rightful development is to commit an unpardonable economic folly. The veriest tyro in the study of economics can prove this to be the case in spheres other than electrical.

Clause (*h*), relating to financial stability, is perhaps necessary to many in the ordinary sense, but it becomes of little value if considered in relation to what has been said regarding the 5 per cent. discount. In general, it matters little to any supplier whether his client is at the moment stable or otherwise, provided that cash is paid with an order. The moral value of financial stability, is, of course, very potent to the credit salesman, but here, even he becomes a "cash sales" man, immediately it is known that his client is troubled financially. This, of course, further demonstrates the uselessness of inserting any clause debarring cash sales.

Sufficient has now been said to indicate what vital results can arise in ordinary business at the present time, by the formation of any trading agreement if it is handled without much thought, and it is now opportune to consider heading 2, *i.e.*, in what proportions are a manufacturer's goods at present disposed of to the would-be contracting parties and to others?

There are few data available on the subject, unfortunately, and much misapprehension would be avoided if some manufacturers would come forward with percentage figures showing to whom they have actually supplied goods, the figures referring to actual £ s. d. proportions. An analysis of one firm' sales (motors, dynamos, &c.), from January, 1923, to December, 1923, inclusive, gave the following instructive figures:—

Sales to other machinery makers	51%
Sales to customers direct	22%
Sales to contractors	9%
Sales to factors	6%
Sales to "both factor and contractor" men	5%
Sales to "no-oncost" men	7%

These figures are most interesting, and bear directly on the question under consideration. It is not suggested that the figures given are applicable universally, but it is considered that, for manufacturing firms, they should not be widely out in the general case. This, of course, can only be substantiated if the various firms of standing and wide outlook will come forward with their own figures, and an appeal is made to them to do so. Sufficient is indicated, however, to show that a great struggle faces both contractors and factors if they seek to frame any agreement which would be the least bit onerous to a manufacturer in respect of a possible loss of sales to anyone. If it is proposed to cut out one class of trader, then it is pretty certain the manufacturer will demand from someone a guarantee of orders covering the value of orders which would so be lost. In the case cited (for which the figures given are perfectly correct) the minimum loss which could be so caused would be 5 per cent., and with a firm of large or even moderate turnover, this would amount to a very respectable figure. Contractors and factors would not *care* to make up such a loss, far less agree to do so.

Now, regarding the actual consumer, is he catered for by all concerned in this matter in a spirit of decent service? Is it not true that in this country, at any rate, the service system is very largely non-existent? How often will a contractor, having duly wired up a house, send a man to inspect the installation even once a year? Judging from the Press comments and the writer's experience, this service is practically unheard of, outside of municipal hire service schemes. The average retailer of electrical goods *sells* his goods—and that's all. The buyer is in general left to use them himself. One has but to turn to the publications of the E.D.A. to find confirmation of this most unfortunate fact. Therein will be found hints and suggestions, encouragement and policies to be acted upon, but it seems that a long time must pass yet ere their full significance will "sink in." The demand for service is insistent, the supply utterly inadequate, and complaints many. A perusal of the discussions at the recent "Salesmanship" Conferences of the E.D.A. will substantiate these statements, and perhaps that should be sufficient; but it is equally true that in no trading agreement seen by the writer (who has scanned quite a number) is there any mention made of the formation of a service to the consumer of any kind. Neither is there a hint of quantity rebates being passed on to him. Surely, the principle of rebates for quantity should be passed on to the consumer. Even if only a small rebate was allowed on say an order for more than four or five fittings at one time, a feeling of confidence would be established between seller and buyer that would do much to improve matters to the mutual advantage of all signatories to any agreement. The point is, really, that the tendency to give rebates does actually exist at present, and indeed is in a certain manner operative. Generally, it is used unfairly, but any agreement could set in motion a system whereby the tendency could be directed to legitimate ends, and the price of an article really reduced to the consumer, who, through oversight, deliberate or otherwise, is entirely forgotten in the contract.

This leads to the consideration of the effect of an agreement on the relationship between employer and employed. At present, it is generally understood that an employé may purchase his firm's goods at reduced prices, subject to his not trading these goods for profit. This means a very considerable saving to the employé and his family, and as there are very large numbers of employés in many firms, the influence of such privileges is much greater than might appear to be the case. Indeed, cases have been known in quieter industrial days when the cancelling of any such privilege has led to strikes with their attendant reflections on the prosperity of the community. How much more, in these days of strife, would the abolition of such privileges react disastrously on the firms concerned? Now, since the employé is also a consumer of the firm's article, the firm would be in honour bound to charge him the sale price in terms of the agreement. In other words, a great privilege must, perforce, be taken away from its employés. Who will deny that just now this would be a most unwise thing to do? Thus, the agreement which made no provision for this contingency would be open to grave suspicion on all sides; the law would regard it as inexpedient, the employer would quietly ignore it, if carried; the employé would create trouble, and the consumer's confidence would be shaken to its foundation.

In conclusion, it will be noted that in the foregoing, no mention has been made of foreign competition. It is a fact to be faced that in many cases foreign-made goods exhibit all the qualities of a good job, and at a price which does appeal to all consumers. There is no need to dwell on the striking significance of this fact in so far as a trading agreement is concerned. As things stand now, the manufacturer finds it a very hard job to meet foreign competition, while large numbers of factors and contractors are actually selling foreign goods on the ground that they cannot sell British goods "because they are too dear!"

What more need be said?

Is it worth while making any agreement at all?

A Universal Meter for Electric Power.

By B. H. SMITH, Supply Engineering Department, Westinghouse Electric and Manufacturing Co.

ONE of the principal reasons for the somewhat unsettled state of the art of metering large quantities of electrical power is the fact that there has been available no completely satisfactory and universal meter. Polyphase alternating current circuits carry most of the electrical energy to-day, and in such circuits the relations between voltage, current, power factor, &c., are complex, and yet must be considered in the buying and selling of electric power.

The purpose of this article is to describe a new kVA meter

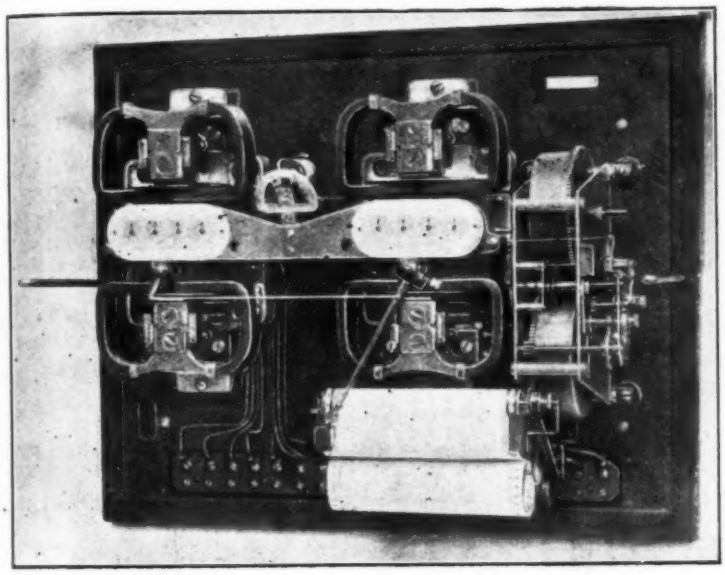


Fig. 1.—Universal Power Meter.

especially well adapted for large power circuits. It gives direct readings of indicated power factor, total kWh, total kVA hours, and kW and kVA demand for any pre-determined time interval; and the power factor for any time interval, particularly at the time of maximum demand, can be readily obtained. With this information practically any kind of power contract can be taken care of.

One of the most important uses of this new meter from the standpoint of large industrial users of power is in connection with power factor correction by means of either synchronous machines or static condensers.

Heretofore it has been impossible to determine the real power factor conditions without considerable difficulty, but with the new meter the load and power factor conditions over a period of time can be read directly, and when corrective devices are put into service the improvements in conditions can be recorded exactly.

The foundation of the meter, which is illustrated in fig. 1, is in a small mechanism which gives a vector addition under all conditions of power factor and load of the quantities which go to make up kVA. It is recognised that the most satisfactory method of measuring kVA in a polyphase circuit is by a vector addition of the power and the wattless components of the circuit. In other words, kVA is equivalent to the square root of the sum of the squares of watt-hours and reactive watt-hours. Watt-hours in a polyphase circuit are readily measured with a standard two-element meter, and for practical purposes a similar watt-hour meter may be connected with its voltage coils arranged with a quadrature connection so that for most commercial loads it will give a satisfactory reading of reactive component. In the new meter the two elements which measure power and reactive component are mounted side by side, and a ball mechanism is mounted between them and mechanically connected as shown in fig. 2 and diagrammatically in fig. 3, so that the ball is driven by the two disks d, and d_1, and in turn drives the wheel w. The condition corresponding to fig. 3 obtains at 70.7 per cent. power factor, at which time the current in a polyphase circuit lags behind the voltage an angle of 45 deg. Under these conditions the watt-hour meter and reactive meter speeds are exactly equal. It is evident then that the ball will rotate about a horizontal axis xy. If the radii a and b are drawn from the point of contact of the wheels d, and d_1 perpendicular to xy, the lengths a and b will be proportional to the watt-hour and reactive meter speed. The wheel w rotates at a speed proportional to the radius of the sphere which is somewhat greater than a and b. It is evident that the two triangles a, b, c are equal, and it can be proved that they are equal for all power factors. Since a, b, c is a right triangle, c, the radius of the sphere, is equal to $\sqrt{a^2 + b^2}$, and therefore we have a true vector addition. The angular motion then of the wheel w is equal to the vector sum of the motions of the watt-hour and reactive meter elements, and is equivalent to kVA-hours. The wheel w is mounted in a frame which moves about an axis perpendicular to the plane in which xy moves, and the axis of the frame would, if extended, pass through the centre of the ball. As the axis of rotation of the ball shifts, the position of w changes so that it always rotates on a great circle with a speed proportional to the radius c. Through suitable gearing the wheel w is connected so as to drive the left-hand dials on the meter, which then register kVA-hours. This regulator is similar to the registers used on watt-hour demand meters, and is similar to the register on the right-hand side of the meter. The pen is removed from the left-hand register, and is replaced by a short arm which through a connecting rod drives the pen on the right-hand element. The right-hand register is connected to the watt-hour meter in the regular manner, but instead of operating a pen the demand mechanism carries a small adjustable stop which moves about the same centre as the pen driven from the kVA element, but follows behind slightly due to the fact that the kW consumption is always equal to or less than kVA. At the end of the time interval when the clock resets the demand mechanism, the kVA element is reset first, and makes a well-defined mark at the end of the line on the paper. The pen falls back to the stop and makes a mark on the paper at this point. A fraction of a second later the kW element also resets and the pointer returns to zero. The record on the chart then gives both kW and kVA demand, and by simple calculation the power factor for the time interval may be obtained by dividing the kW by the kVA demand. The indicated power factor at any time may be obtained by inspecting the position of the pointer carried by the frame on the ball mechanism.

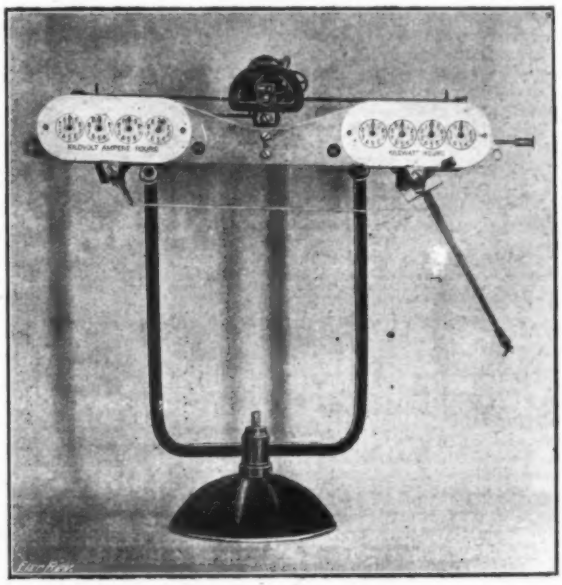


Fig. 2.—View of Ball Mechanism, &c.

Referring further to the ball mechanism, figs. 4 and 5 show the different positions of the axis of rotation of the ball. In fig. 4 the watt-hour meter speed is slightly greater relatively than fig. 3, and the radius a is greater than the radius b. In this instance the power factor is approximately 80 per cent. In fig. 5 the reactive meter is at rest, and the

ball rotates, about an axis passing through the point of contact of the disk d_1. In this position it is clear that there is a 1 to 1 ratio between the disk d_2 and the wheel w with a resulting kVA-hour registration equivalent to kW-hours. As the power factor becomes less than 100 per cent., the reactive meter starts to rotate, and, referring to fig. 4, again the ratio of a/c is the cosine of the angle which measures the departure of the axis xy from the unity power factor position. When the mechanism has reached the zero power factor position the axis xy passes through the contact of the disk d_2, the watt-hour meter being at rest. In this position there is a 1 to 1 ratio between the reactive meter disk and the wheel

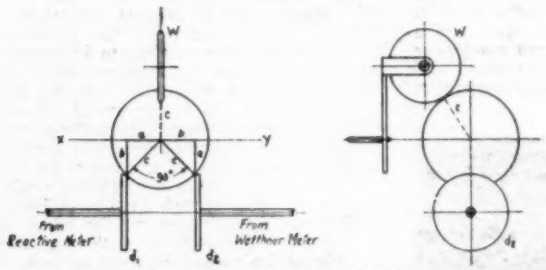


Fig. 3.—Position of Mechanism at 70 per cent. Lagging Power Factor.

w making reactive watt-hours equivalent to kVA-hours. With a leading power factor the reactive element reverses, and the axis of rotation becomes vertical, but the wheel w still gives a correct integration of the vector sum of the motions which go to make up kVA-hours. This could be carried through the whole circle diagram of leading and lagging power factor and reverse power, but with reverse power the wheel w would have to be driven from the lower part of ball, and this would cause mechanical interference.

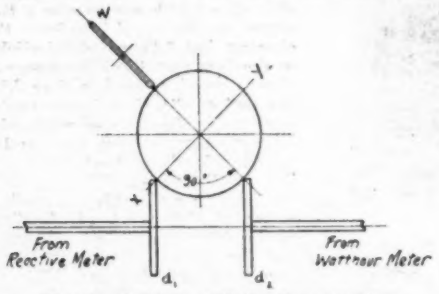


Fig. 5.—Position at Unity Power Factor.

There might be some question whether there would be any slipping in a friction drive of this sort, but measurements show that the power required to operate the pen and the kVA counter mechanism is only one-eighth of the power required to slip the wheel w on the ball. By checking the rotation of the wattmeter disks against the record on the chart, it is found that proper registration is transmitted, which proves that the ball functions correctly.

The Electrical and Engineering Exhibits at Wembley.

Preliminary Notices.

(*Continued from p. 596.*)

Messrs. Drake & Gorham, Wholesale, Ltd., have opened a trade sales counter at the Exhibition, where large stocks of cable, conduits, ironclad switchgear, wiring accessories, fittings and lamps are available. We have no doubt that the facilities thus placed at their disposal will be much appreciated by a number of exhibitors.

The British Electrical Development Association informs us that Messrs. Imrie & Angell, architects, were responsible for the design of the structures and other decoration of its display, and gave valuable assistance with regard to furniture, the arrangement of lighting, choice of fittings, &c.

The City Service Bureau will supply office staff by the hour or day to exhibitors in the Palace of Engineering.

The Heatly-Gresham Engineering Co., Ltd., is to show petrol, oil, and gas engines of various sizes, including a 10-b.h.p. engine driving a 6-kW generator, iron castings, a model of a patent lubricating system, steel drop forgings, &c.

Messrs. Ferranti, Ltd. (Hollinwood), are supplying two 500-kVA, 3-phase, 6,600/3,300/450-V transformers for the substations, a 50-kVA, 3/6-phase rotary transformer for Messrs. Mather & Platt, Ltd., and a 100-kVA 3-phase transformer for Callender's Cable & Construction Co., Ltd. In addition, the company is showing meters, instruments, models of protective gear, &c.

Mr. E. L. Hopkins will show and demonstrate the "Clarocit" preparation for preventing condensation on windscreens and other glass surfaces.

Mr. J. Lightfoot will show his tubular electric heating system applied to towel-rails, radiators, garage and car heaters, the "Litent" reflector fitting for use in explosive buildings, &c.

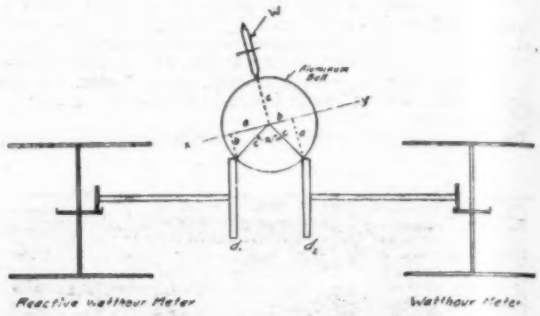


Fig. 4.—Position at 80 per cent. Power Factor.

The Wireless Lights Syndicate, Ltd., will exhibit advertising signs.

The City Accumulator Co.'s exhibit will consist of "O.A.C." crystal and valve radio receiving sets and components.

Messrs. F. Reddaway & Co., Ltd. (Pendleton), are showing camel-hair belting, india-rubber products, including valves, sheet, rings, hose, &c., high-pressure hose, and many other similar articles.

Messrs. Slack & Brownlow (Tonbridge), will show the "Brownlow" filter for purifying water.

Messrs. D. Ashton & Co., Ltd. (Sheffield), are exhibiting 5 and 10 h.p. "Little David" internal-geared clutch-controlled haulage gears with direct-coupled totally-enclosed squirrel cage motors.

Messrs. Robert Blackwell & Co., Ltd., are arranging a display of overhead equipment for 11,000, 6,000, and 3,000-V electric traction, catenary and trolley wire suspension fittings and insulators, roofing felt, &c.

The Electro-Mechanical Brake Co., Ltd., is to show steel-cased controllers for cranes, winches, trolley 'buses, battery vehicles, &c., and "E.M.B." jointless and rustless resistances for traction and industrial purposes.

M.K. Electric, Ltd., will exhibit "M.K." accessories, including plugs and sockets, d.p. switches, control boards, and connectors.

The British Vacuum Cleaner & Engineering Co., Ltd., is to display vacuum cleaning equipment for various purposes, and a suction boiler-flue cleaning plant.

The Firth Co., Ltd., is exhibiting all classes of wire and gauze in a number of metals.

The Burntisland Shipbuilding Co., Ltd., will have a collection of photographs of vessels which it has built.

The Berkefeld Filter Co. (British) will show high- and low-pressure water filters, including one in combination with a power pump.

Graphite Products, Ltd., is arranging a collection of graphite lubricants for a variety of applications.

The British Ropeway Engineering Co., Ltd., will have a working model of an aerial ropeway, models of undertype and overtype bi-cable carriages, &c.

Aerostyle, Ltd., is showing a number of spraying machines for industrial painting, &c.

Messrs. Broom & Wade, Ltd. (High Wycombe) are to show air compressors of various sizes driven by steam and oil engines.

Messrs. C. A. Parsons & Co., Ltd., will have as their main exhibit a 12,000-kW, 3,000-r.p.m. turbo-alternator, one of the five sets being constructed for the South African Electricity Commission. Apart from this they will exhibit scale models of turbines and turbo-alternators, turbine blading, searchlight reflectors, &c.

The Jackson Electric Stove Co., Ltd., is to have a display of cooking equipment for private and public use, water-heating apparatus, kettles, irons, and other domestic apparatus.

Simms Motor Units (1920), Ltd., will exhibit high-pressure magnetos, and patent flexible vernier couplings.

Newalls Insulation Co., Ltd., is to show magnesia and cork steam and heat insulating compositions, including a section through a ship's hull showing an insulated cold store and galley.

The Perfect Patent Co. (Brentford) will exhibit examples of its adjustable spanners and ratchet wrenches.

The Kennicott Water Softener Co.'s display will consist of water-softening plant for domestic use. The company has installed a lime and soda softener in the power-station boiler-house.

P. & B. Evaporators, Ltd., will show a non-scaling evaporator for distilled water.

(To be continued.)

The Cable Accessories Co.'s Works.

"Revo" electrical specialities are too well known to need any introduction. Nevertheless, a visit to a factory wherein is produced some familiar commodity is always an interesting and instructive event, and our recent tour of the Britannia Works of the Cable Accessories Co., Ltd., of Tividale, in Staffordshire, proved to be no exception to the rule.

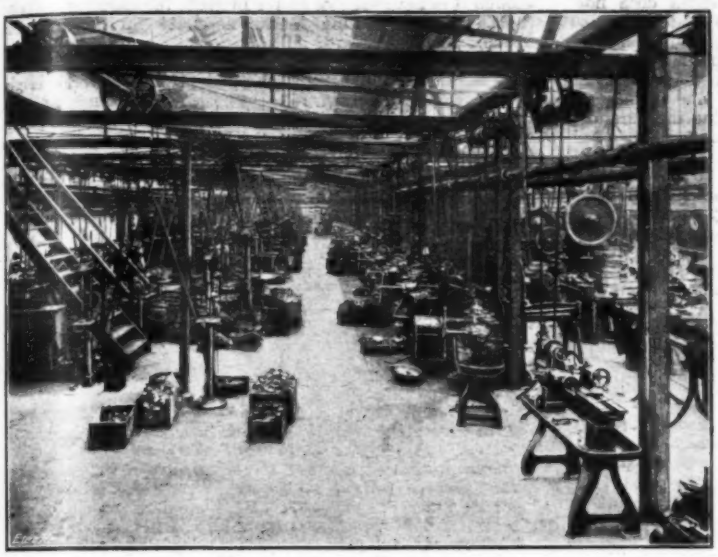


Fig. 1.—The Machine Shop.

The history of the company may be assumed to commence from the time the present management took charge in 1909, at which date the firm was manufacturing joint boxes, feeder pillars, and other underground cable accessories. In that year, however, the present managing director, Mr. F. H. Reeves, conceived the idea of producing electric light fittings of the industrial type, both in cast iron and sheet steel.

At the time the firm was employing about 50 workpeople in small rented premises under very adverse conditions, but the new activities speedily brought a change over the business which compelled the purchase of about 20 acres of land in Tividale and the erection thereon of a modern steel, concrete, and brickwork structure. The new premises were entered into in August, 1914, and as was the case with so many other concerns, the works were utilised for the production of munitions of war, being under Government control from the start.

The growth of the business had been such that by that time it was affording employment for some 400 people and, in addition to lighting fittings, which had become the principal product of the firm, new lines quickly followed each other until to-day the manufactures may be said to comprise watertight, street, bulkhead fittings and cargo lights; pendants, brackets, and hand lamps; winches, hoists, and pulleys; fires, hot plates, boiling rings, irons, and kettles; fans, house service and industrial switch and fuse gear, tumbler switches, wall plugs, lampholders, shock absorbers, bells, plugs and sockets, &c. Another line that requires mentioning is broadcast radio telephone apparatus, "Revophone" crystal and valve receivers being produced, as well as "Revo" loud speakers.

The main shops, of which the accompanying illustrations convey some idea, consist of bays of 30 ft. by 280 ft., all under one roof; the shops are heated by means of hot water pipes and electrically lighted and driven throughout. The works are quite self-contained, no factoring being done, and every article is actually manufactured entirely from raw materials. In fact, shortly after the outbreak of the late European war difficulty was experienced in procuring vitreous-enamelled goods; the firm thereupon built a new factory and equipped it with enamelling plant; it also bought and equipped a modern iron foundry, and later on added a brass foundry and wood-working department, so that the firm now owns and controls three subsidiary companies, namely, the Eagle Iron Foundry and the Groveland Brass Foundry Co., both in Tipton and the Tividale Enamel Co. The last-named has developed a big line in hearth plates for artisans' dwellings, and claims to be probably the largest manufacturer of such products in England; enamelled iron shades of all descriptions, both for gas and electric lamps, are made, and enamelling for the trade is also undertaken.

Fig. 3.—Another Assembly Shop.

Fig 2.—Apparatus Assembly Shop.

The Cable Accessories Co., Ltd., now has a pay roll on which are the names of some 1,200 employés, about half of whom are women, for whose comfort and convenience an excellently appointed canteen has been built. During the last five years the firm has established depôts with show and stock rooms at London, Glasgow, Newcastle-on-Tyne, Cardiff, and Dublin. At the two first-named places fleets of motor lorries are maintained for goods delivery purposes.

German Goods for Ireland.—At a meeting of the Council of the Cork Chamber of Commerce recently, a letter was read from the German Consul-General at Dublin, requesting the Chamber to recommend Irish representatives for several lines of German goods, including electric switches and switchboards, gas purifying plant, ventilators, &c. The Council gave attention to the matter.

British Prospects in Portugal.

"With improved transport and the efficient application of capital, Portugal would become one of the richest small countries in the world."

This phrase is contained in the report* by H.M. Consul at Lisbon (Mr. S. G. Irving), which has just been issued by the Department of Overseas Trade. The Consul does not ignore the need for a drastic curtailment of the State expenditure. Nor does he overlook the fact that a series of political revolutions over a term of years, though minor in character, has been unsettling to trade. But the idea that Portugal is impoverished is, he says, a misconception, due mainly to the fall in the value of the escudo. He explains the paradox of the exchange rate by the large sums of sterling which have been accumulated abroad, mostly in England, by Portuguese subjects, and by the accumulated hoardings of gold by the country people. Portugal, in the Consul's opinion, can only be described as prosperous. There is practically no unemployment, and the manual worker was never so well off as he is to-day.

Great Britain remains Portugal's best customer, and on that account she should be in a good position to obtain orders for Portuguese requirements from abroad. In fact, she is the chief supplier to Portugal of coal, tinplate, and textiles, and the intermediary for the supply of American cotton, Argentine wheat and Newfoundland cod.

As soon as the political situation is more settled and the escudo becomes fairly stable there should be good work for the British engineer in Portugal. Much road and railway construction and repairs are badly needed; coal mines and waterfalls await development, and for the resultant power there is scope for employment in mines and factories. The latter, particularly the textile group, expanded considerably during the war.

Mr. Irving reviews the trend of trade in the various branches in recent years. In iron and steel, railway material, and other engineering products Germany, France, the United States, Spain, Italy, and Belgium all compete with Great Britain. Manufactured copper comes chiefly from the United Kingdom.

With regard to industrial machinery, the Consul says that German goods, although not considered as good as British, are being more widely sold owing to their low price. This applies especially to wood-working machinery, but British textile plant can still be sold, as well as most other kinds on a restricted scale. Orders have been placed in England recently by one company to a value of £180,000. A British humidifying and de-humidifying plant worth over £40,000 is being installed in the Alcantara works of the Companhia Industrial de Portugal e Colonias. This will be the first of its kind in the Peninsula. Other orders from Britain are pending. The preference for British manufactures is estimated at between 10 and 15 per cent.

British machine tools, owing to their superior reputation for reliability, still compete to some extent with the German product, in spite of a difference in price of 25 per cent. A number of lathes, drilling machines, &c., have been sold recently. Hand tools are mainly German. A long-established Sheffield trade in files is in danger of being destroyed by a prohibitive new customs duty, but it is hoped the rate may be modified.

Very little British electrical machinery comes to Portugal, although the demand is considerable. In this line, only the cheapest product is bought as a general rule. 1922 showed an increase in the imports of British direct-current generators. British gas engines are preferred, and lead the trade. Germany, the United States, Belgium, and Spain are, however, competitors. "The British share might be largely increased if prices were brought down. At present they are very high." A few British flour mills were sold in 1923. Cranes were imported from Great Britain in 1922 to a value of £36,600. The sewing machine trade is entirely in the hands of Singers.

Methods and Precautions.

With regard to future prospects for British trade, H.M. Consul recalls that the reputation of the Portuguese market has suffered in consequence of difficulties lately experienced by a number of British firms in obtaining payment for goods supplied. After the war mushroom concerns sprang up to participate in the boom. Many of them had no capital and no reserves, and when the slump came and the escudo collapsed, they were entirely unable to meet their engagements. These conditions date back to 1920, and it will be found that most of the bad debts in Portugal go back to that year and the year 1921. Most of the older houses were also heavily hit, but the great majority did their best to meet their obligations. Seeing therefore, that, as a whole, the genuine firms have continued to pay up, Mr. Irving says that British manufacturers would be making a mistake to fight shy of the market on account of the failure of contracts entered into with untried firms during the boom. A good many, probably most, of the speculative concerns are now known, so if proper precautions are taken there is no reason why bad debts should be regarded any longer as unavoidable. Fluctuations of exchange must, of course, be guarded against, but the lowness of the rate in itself is not an insuperable barrier to trade.

Portugal is a live market and easy of access, with great potentialities both at home and as a channel of supply to the Colonies. The people are well provided with money though it is not available at the moment for discount purposes. Stocks are low, owing to the necessity for limiting risks. Trade has bristled with difficulties since the boom, but conditions are not so bad as they were two years ago, nor so bad as they are generally believed to be. Several English travellers in 1923 discovered business the existence of which they had hardly suspected. It is there for those who take the trouble to seek it out. Some go away disappointed because though they know the selling points of the goods they have to sell, they do not know the manner of client with whom they have to deal.

The Consul adds that the best way to do business with Portugal is first to visit and investigate the market in person, then to appoint a local agent. Preliminary information as to the existence of openings can be obtained by reference to the Department of Overseas Trade. The greatest care should be exercised in the choice of agents, and no less in the selection of clients. Bank references should always be insisted upon.

Water Power.

As regards advertising, it should be borne in mind that only one-fourth of the people can read. To convey any meaning, therefore, advertisements must be pictorial and preferably coloured. The cost of advertising is cheap. Catalogues and circulars in Portuguese are the most likely to bring results owing to their scarcity, which would be less surprising if the same language did not apply equally in the valuable Brazilian market. Little progress has actually been made in the exploitation of Portugal's waterfalls, despite the protracted discussion of the Douro project. Mr. Irving points out that the amount of water power actually developed is about 16,000 h.p. out of a total estimated power of 500,000 h.p. Nearly half of this total is in the Douro basin on the Spanish frontier and the two Governments concerned seem unable to come to an agreement regarding their respective rights, though failure to do so deprives both countries of a valuable asset. There remains an undisputed balance of 250,000 h.p., of which 70,000 is credited to tributaries of the Douro, 38,000 to the Cavado, also in the north, 40,000 to the Tagus, and 30,000 to the Guadiana in the east, on the Spanish frontier.

Numerous schemes have been drawn up for exploiting the various falls, but no large capital investments have been made. All the estimates, remarks the Consul, need careful verification, and it is probable that the actual working power would prove to be lower than the figures given. Even so, these resources of electrical energy are by no means negligible in a small country which is spending from two to three million pounds on imported fuel at a very unfavourable rate of exchange.

* H.M Stationery Office.

Wades' Tables for Wooden Poles.—Some 16 years ago Messrs. Richard Wade, Sons & Co., Ltd., at their own expense compiled a volume of tables relating to overhead lines carried on wooden poles, and giving the data necessary for the design of pole lines for all purposes, such as the wind pressure on wires and poles, gross and net safe loads, elastic deflection of poles, standard sizes of poles, &c., in accordance with the existing Board of Trade regulations for overhead lines. Many thousands of these useful tables, revised when necessary, were circulated to the trade free of charge. Now, however, owing to the issue of the revised regulations by the Electricity Commissioners, the tables have become out of date, and Messrs. Gabriel, Wade, & English, Ltd. (with whom the above-named company is incorporated) propose to issue revised tables in compliance with the new regulations, provided that sufficient support is received from the industry. The new issue will deal with both high- and low-pressure lines, and with the new Rutter pole, which has been successfully tested, and as the whole of the data will have to be recalculated, considerable expense will be incurred; a charge not exceeding 10s. per copy will be made, which will be reduced if sufficient copies are ordered, as the publishers do not seek to make a profit on the issue. Readers who are interested in overhead work should write to Messrs. Gabriel, Wade & English, Ltd. (Dept. C.), Garrison Side, Hull.

Swedish Trade with Australia.—The Swedish General Consulate in Sydney has telegraphed to the Government in Stockholm announcing that the Australian dumping law will be applied to induction motors from Sweden, which country specifies a lower price than the manufacturer's sale price for similar Australian motors. The decision in this respect implies that a special dumping tax will be imposed upon such motors, amounting to the difference between a reasonable market price at the time of forwarding and the export price. It is added that it is so far unknown whether the application of the law will be retroactive.

The Registration of the Electrical Contractor.

By ALEXANDER LINDSAY.

(*Abstract of paper read before the* Glasgow Electrical Society.)

The licensing or registering of the electrical contractor is at present receiving much attention throughout the country, as it seems to be the only solution of certain abuses and weaknesses in the trade. The work of the irresponsible contractor who has just sufficient knowledge of the trade to be dangerous, tends to discredit the business and to injure the legitimate and well-qualified contractor. A licence in itself will not afford assurance of safe or honest work, but merely that the licensee is in a degree competent to engage in the work. The authority to issue a licence must always carry with it the means to revoke it for improper practice and violation of its provisions, and herein lies the power of "registration," which, it is hoped, will tend to dignify the electrical contracting business, give it official recognition, and place it on a higher plane in the mind of the public. It will tend to fix responsibility and guarantee compliance with rules laid down by the Institution of Electrical Engineers, fire offices, and the municipal authorities. It is the hope of the Authority that every contractor will take an active personal interest in the subject, and the co-operation of all the electrical interests must be secured.

Registration is not intended to create a monopoly for the electrical contractor or to restrict the freedom of those who wish to engage in the business. So far, there is no suggestion of licensing or registering workmen; the responsibility should rest entirely with the master electrician.

For a considerable number of years there has been a widespread demand from electrical contractors for all contractors to be registered; steps were taken in 1917, and in 1919 a deputation waited on the Board of Trade, but the Board declined to bring in legislation for compulsory registration. Schemes of registration are in existence in many towns in the United States, and have been under consideration in the Dominions. In every case in the United States the registering authority has been appointed by the State with full powers to examine applicants and to grant or cancel licences, the expenses being defrayed by the applicants. In all cases the powers to grant licences are associated with rules and regulations for the safe execution of electrical work, and the principle is maintained in the Dominions that wherever rules are enforced by the legislature there must be licensed or registered contractors to carry out the work. The fees for registration vary from £1 to £15 for the first year, dropping in some cases to as low as 5s. per year afterwards.

The Committee of the E.C.A. suggested to the Board of Trade that Parliament should be asked to give either the Board of Trade or the Electricity Board power to make it unlawful (under penalty) for any person or body to engage in the business unless he or it was registered. Compulsory registration in the opinion of many members of the Association would be best for the industry, but on the refusal of the Board of Trade to introduce it, the Institution of Electrical Engineers was approached and a conference was held under its auspices, which appointed a committee to draw up a voluntary scheme, leading to the registration scheme that is now in force.

The National Register of Electrical Contractors was registered on November 19th, 1923, as a company limited by guarantee, with 100 members, each liable for £5 in the event of winding up.

Its main objects are to afford to the public the means of distinguishing electrical installation contractors, to raise the efficiency and status of contractors, to set up and maintain a register of qualified contractors in the British Isles, to promote standardisation, and to encourage invention. For these purposes the Authority will secure recognition by the Government and other authorities, technical schools, &c., conduct examinations, and grant certificates, issue licences to registered contractors to use authorised distinguishing marks or devices, publish the names and addresses of registered contractors, make rules and regulations, maintain a high standard of workmanship, and collect and publish information for the benefit of its members and persons on the register.

The Council of Management includes representatives of all the bodies concerned, and has appointed an executive committee; the rules and regulations relating to registration have been issued to all members of the E.C.A. Application for registration should be made to Mr. Trimnell, 1, Lincoln's Inn Fields, London, who is the secretary of the Authority, and who will furnish forms of application and other particulars.

Had this scheme not gone through, the question of registration would have been dead for some years. It has not been drawn up so as to close the industry against the entry into it of properly qualified persons, nor is it a method of forcing contractors into the E.C.A.

If compulsory registration is to be sought, it will now be most hopefully sought through the adoption and trial of this voluntary scheme, which will indicate to all concerned to what extent compulsion is desirable or necessary.

It is desirable that all the bodies concerned should, in the interests of the scheme, have an adequate voice in its control. There is not the slighest danger that the scheme will be administered to the disadvantage of contractors by an Authority so constituted.

Several contractors were inclined to oppose voluntary registration or compulsory registration on the following grounds:—

(1) At present they themselves do first-class work, and when told their prices are high they are able to refer to the difference in standing and reputation built over a long period of years, and suggest that the difference in price is due to the different quality. They feared that registration would give the inferior firm the means of saying: "I may not have been in existence so long or have as big a reputation behind me, but after all I am a registered contractor and so are they." In other words, to the uninformed the registration certificate might seem to put the inferior man more nearly on a level with his superior.

(2) It was feared by some organisations in the electrical industry that registration might tend towards the raising of costs, but I think I can safely leave the meeting to deal with this absurdity.

(3) It has been said that impositions and regulations may restrict the industry or put up prices. The scheme does not contemplate the imposition of regulations other than such minimum as may from time to time be found necessary in working the scheme to enable the registering authority to be on sufficiently secure ground in the event of its desiring after an investigation of a complaint to remove a contractor's name from the register.

(4) It has been said that the scheme places onus on the supply authorities to see that the work of contractors comes up to the required standard.

The scheme does not place onus on anyone. It merely holds over the head of the contractor the fact that there is an authority to whom complaints may be made, by whom they will be investigated, and if they are found justified and serious, they will render him liable to have his name struck off the register. I think you will agree with me that it is better that this power should be given to an independent registration authority rather than a local supply authority.

(5) It has been said that registration will tend to make the industry a closed one. Every facility is provided intentionally by the scheme for admission in the first instance of almost everyone in the industry or wishing to enter it. The essence of the scheme is not to be selective, but to remove from the register unsatisfactory firms.

(6) It has been said that the scheme, which only concerns contractors, should be entirely worked by them. The advantages of the scheme apply to the whole industry, and it will benefit all sections.

(7) It has been said that registration is a means of increasing the membership of the contractors' associations, and giving them control. These associations do not desire the control, but are most strong in the view that the scheme must not be theirs, but the industry's, and that it should have the support of, and be controlled by, the interested parties, *i.e.*, consulting engineers, architects, the I.E.E., supply authorities, fire offices, and contractors. There is no advantage under the scheme for the member of a contractors' association, as distinct from the non-member, who is explicitly given representation on the authority.

(8) It has been said that this is the thin end of the wedge of compulsory registration. The scheme is entirely a voluntary one, and involves no compulsion on anyone. There is no obligation for any supply authority which does contracting work to become registered.

The scheme is designed to be entirely self-supporting.

I hope that you will agree that it is not only the duty but the privilege of every self-respecting qualified electrical contractor at once to become associated with this scheme, as I firmly believe that it will prove of great benefit, not only to the whole industry but to the general public.

New Argentine Tariffs.—From a list published in the *Board of Trade Journal* it is seen that among the articles affected by the new Argentine Customs tariff law are wires and cables. Included in the free list are motors and dynamos, and machines, &c., for public lighting. The complete text of the Decree (in Spanish) may be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Power Circuit Interference with Telegraphs and Telephones.

By S. C. BARTHOLOMEW, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The paper is a general survey of the position, and opens with a description of the features of modern generation and distribution of electrical energy which are responsible for interference with telegraph and telephone circuits, emphasising the importance of harmonics in this connection, and indicating some known remedies which may be applied to power plant at its source when trouble is experienced.

The greater development and the different conditions in the United States have resulted in the problems developing earlier, and apparently in a much more violent form, than in this country, and has culminated in the appointment of joint committees of the National Electric Light Association and Bell telephone systems on the physical relations between the electricity supply and signal systems.

In this country we have not had the same widespread problems. The troubles have been more in the nature of isolated incidents, and the need for research on anything like the scale found necessary in America has not arisen. This can partly be explained by the fact that until the last few years there was little distribution of electrical energy by overhead lines, the development being almost wholly underground. Further, where overhead high- and extra-high-pressure lines have been erected, cross-country routes have been the rule, and in few cases are the routes parallel with and in close proximity to the main trunk lines of the Post Office which follow the public roads.

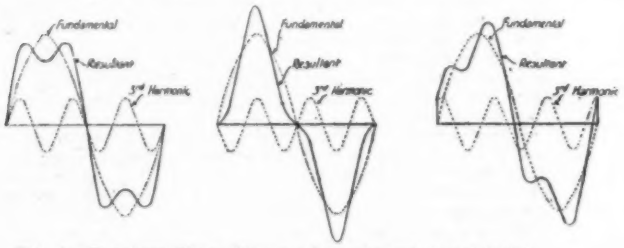


Fig. 1.—Resultant Wave Shapes of Fundamental and Third Harmonics.

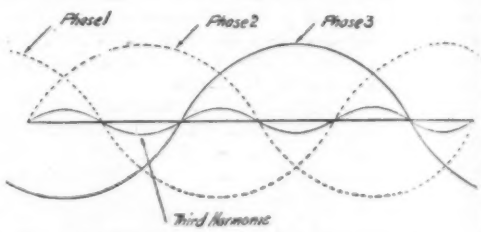


Fig. 2.—Fundamental Waves and Third Harmonic in a 3-phase System.

It is not claimed that the matter presented is new or the treatment original, but hitherto the salient points bearing on the subject have not been easily available.

Power circuit voltages and currents are classified as: (1) Balanced voltages and currents, and (2) residual voltages and currents, the former being balanced, whilst the latter are unbalanced with respect to earth. At any instant the algebraic sum of either the balanced currents or the balanced voltages in the several conductors is zero, whilst the algebraic sum of the total currents in the several conductors is the residual current, and the algebraic sum of the total voltages to earth is the residual voltage. A circuit consisting of an overhead trolley wire with an uninsulated rail return is wholly unbalanced with respect to the earth, the total voltage and current being residual. On the other hand, a double-wire circuit with no connection to earth and conductors arranged symmetrically with respect to the earth and other objects would have neither residual voltage nor current, as the voltage to earth on one side would be equal and opposite to that on the other. The same would apply to the current, and in that case both voltages and currents are wholly balanced. Excepting the cases of traction systems employing earthed returns, the balanced voltages and currents are those which perform useful work in the circuit, whilst the residuals perform no useful part in the operation of the system, and are, in fact, a measure of the failure to reach a perfect design in the apparatus and line, having in mind other interests.

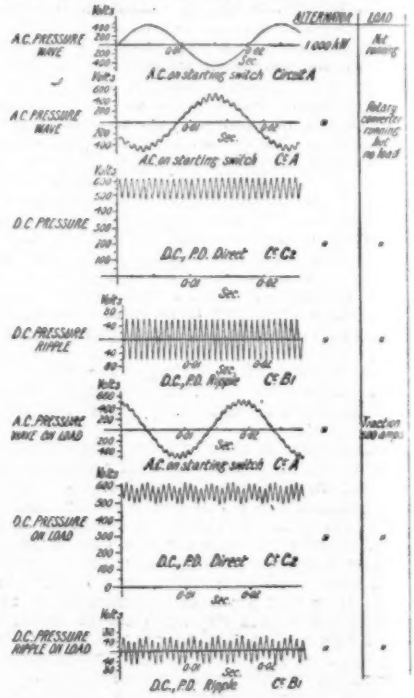
The inductive effects of the different types of power circuits as used commercially are dealt with under their respective heads, but common features which affect the intensity of disturbance may be summarised as follows:—

Avoidance of close proximity between power wires and communication circuits is the only sure way of preventing disturbance. *The use of apparatus (rotating machinery and transformers) designed or worked in such a way as to be free from harmonics,* to which the bulk of inductive interference with telephones is due.

Restriction of residual voltages and currents is particularly difficult in the case of traction systems using track returns. In the case of ordinary power systems they can be lessened by line balance, by the avoidance of excessive magnetic density in transformers, by avoiding certain transformer connections, and in some cases by the provision of supplementary devices which suppress or short-circuit the harmonic components. These effects are not reduced by transposing the power lines, except in so far as it assists in equalising the capacities of the conductors to earth.

Transposing the power line conductors will reduce the possibility of inductive effects due to balanced voltages and currents. *Transposing the communication circuit conductors* will reduce the effects of residuals and balanced voltages and currents. It applies more particularly to telephone circuits which are, with very few exceptions, equipped with two conductors. Telegraph circuits are, with few exceptions, one-conductor circuits with earthed returns, and hence cannot be transposed.

Electrical balance of communication circuits is important. A telephone circuit with its two conductors and apparatus perfectly balanced as regards series impedances, capacities, and leakage to earth, and with both conductors exposed uniformly to the inductive effects, would be free from disturbance. Unfortunately, such ideal conditions cannot be obtained in practice. The varying weather, trees, the small boy with the stone, are factors which would defeat the most skilful balancing of the terminal apparatus, even if it were commercially possible to provide apparatus balanced to fulfil laboratory requirements. Circuits in underground cables are not included in the above list of disabilities. *Abnormal conditions on power systems* may cause disturbance of a very serious character in neighbouring communication circuits, even if they are not of long duration.


ALTERNATOR
LOAD
A.C. PRESSURE WAVE
1 000 kW
Not running
A.C. on starting switch Circuit A
A.C. PRESSURE WAVE
Rotary converter running but no load
A.C. on starting switch Ct A
D.C. PRESSURE
D.C., P.D. Direct Ct C2
D.C. PRESSURE RIPPLE
D.C., P.D. Ripple Ct B1
A.C. PRESSURE WAVE ON LOAD
Traction load amps
A.C. on starting switch Ct A
D.C. PRESSURE ON LOAD
D.C., P.D. Direct Ct C2
D.C. PRESSURE RIPPLE ON LOAD
D.C., P.D. Ripple Ct B1

A Two other rotary converters practically free from ripples also running.

Fig. 3.—Oscillograms showing Rotary Converter D.C. Ripples and Reactive Effects on A.C. Wave at Slip Rings.

To appreciate the effect of small currents in producing noise in telephone circuits, it should be borne in mind that a small fraction of a microwatt of power at voice frequencies will produce an audible sound in a telephone receiver. The

frequencies of voice currents in a telephone circuit vary between 100 to 4,000 cycles per second. This last figure may seem a high one, but it should be borne in mind that we are dealing with the currents produced by the overtones as well as the fundamental pitch of the human voice (the pitch of male singing voices usually falls within the frequencies 80 to 500 per second, and of female voices between 160 to 700 per second). The mean frequency of these varying currents is found to be 800 per second, which is the figure used for telephone transmission calculations.

Any extraneous currents in a telephone circuit having frequencies within the limits mentioned will therefore have deleterious effects on the efficiency of a circuit, particularly so with extraneous currents of frequencies between 800 and 1,200 cycles per second. The effects of an extraneous current at a frequency of 25 cycles per second is about 1/1,000th of that produced by a current of the same strength at a frequency of 1,100 cycles per second.

Power circuits do not usually operate at a higher fundamental frequency than 60 cycles per second, and there is little interference with speech from the fundamental frequency. It is unfortunate, however, that there are usually present,

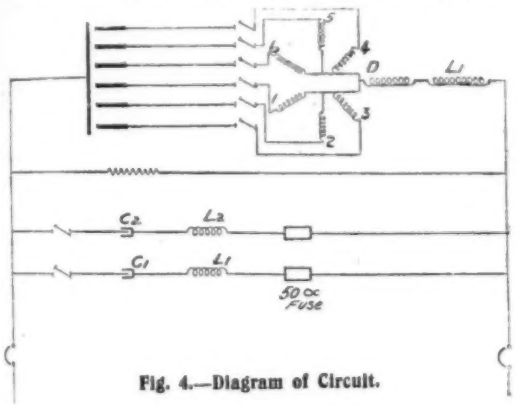


Fig. 4.—Diagram of Circuit.

due to various causes, harmonics on the fundamental voltage or current wave which are within the range of the human voice, and it is these harmonics which are the chief cause of interference with telephone circuits.

The amount of noise that can be tolerated on a telephone circuit without undue interference with speech has not been specially investigated by the Post Office. It is difficult to fix a maximum allowable noise. Any public telephone circuit in this country is likely to be joined through to any other, wherever situated, and the cumulative effect might be disastrous. Each circuit taken alone might be tolerable, but in combination unfit for public service.

In power systems high-frequency components are present in the current and voltage waves. A brief account is given of their principal causes and some known remedies. *Slot harmonics* are produced by practically all generators and motors, and are the most frequent cause of disturbance in telephone systems.

These slot ripples are usually specially objectionable, as they fall within the speech frequencies. The main consideration is to avoid variations in the magnetic field in the air-gaps, and conditions may be improved by arranging for the gradual increase in the air-gap towards the tips of the pole. There will then be a corresponding gradual change in the flux in any particular tooth as it passes into or out of the influence of the pole. Further improvements may be introduced by skewing the pole tips so that the teeth come gradually into or out of the influence of the pole, usually effected by cutting the pole tips diagonally. Harmonics are not so prominent if large air-gaps are used or if the slots are nearly closed, and also when the number of slots per phase is not a multiple of the number of poles.

The B.E.S.A. Standardisation Committee on the wave-shape of alternators has considered the effects of irregularities in producing interference with telephone circuits. The present standard, the author understands, is now being reconsidered. Both the British and the American Committees have before them evidence that harmonics between certain frequencies are particularly harmful so far as inductive interference is concerned. The sensitiveness of the telephone receiver to the same current at different frequencies has been determined by observation. Osborne states that "it is estimated that at 1,000 cycles the interference per volt is approximately 9,000 times that at 60 cycles, and 60,000 times that at 25 cycles."

It is believed to be the intention of both committees to penalise wave-shapes which contain the frequencies mostly affecting telephones. It should not be overlooked that the third harmonic, although not in the range, is very likely to cause disturbance to telegraphs. The effect of the third harmonic in distorting the wave shape has an important bearing on interference from three-phase systems. Fig. 1 shows the three ways in which the fundamental and the third harmonic can be combined to produce different resultant wave-shapes. In each case, however, the third harmonic is in phase, and as it completes one period in 120 degrees of the fundamental it does not appear between the three conductors or load. Fig. 2 illustrates the conditions. If there is only the one earthed connection on the system the effect could be considered as a voltage effect only, except that a charging current alternates between the neutral point through the winding of the machine and through the capacity of the lines to earth. If the system is extensive, this charging current may be very considerable, it being understood to be in some cases in this country as much as 90 amperes. In addition to the third harmonic, odd multiples of the third may appear and act in the same way.

Two methods of overcoming this trouble at the source have been successfully used on a small scale. The first was described by Prof. E. W. Marchant and Mr. T. H. Turney before the British Association at Liverpool in September, 1923. It depends upon the placing of resonant shunts across the phases, the shunts being tuned to the harmonic that it is desired to suppress in the phase. The other has been applied by the British Thomson-Houston Co., and was described in correspondence in the *Electrician* and ELECTRICAL REVIEW of November 2nd, 1923. This method depends on the use of filters tuned to reject the frequency current which it is desired to suppress as has been employed in wireless reception.

Of recent years a great deal of trouble has been caused by harmonics produced by rotary converters, as they are now commonly used for supplying direct current to traction systems where the power system is usually unbalanced and the residual voltages and currents are considerable. The speed of machines is usually such as to produce harmonic frequencies likely to disturb speech, and slot harmonics may be greatly accentuated by the arrangement of the damper bars in the pole-shoes. In certain machines where severe interference has occurred, the distance between the damper bars has been found to be equal to the pitch of the slots. It is thought that the damper bars cause changes in the density of the flux or tufting of the field in their neighbourhood, and, as the pitch or distance between the slots is equal to the distance between the tufts, there is simultaneous cutting of the denser parts of the field by all the conductors of the armature and the amplitude of the harmonic is consequently increased. One of the remedies is to shift alternate pole-shoes or poles half a slot-pitch, or each pole-shoe or pole a quarter of a slot-pitch, one in one direction and the next in the opposite direction. In either case there will then be alternate short and long gaps between adjacent pole-shoes, and, as the conductors will not be affected simultaneously by the tufts, the harmonics will be out of phase and the ripple will be largely wiped out.

The improvement effected by alterations to machines which had been found to offend in this respect, in this case by altering the spacing between pole-shoes, is shown in fig. 5. The interference was caused by a tramway system, the direct current of which was obtained from rotary converters run

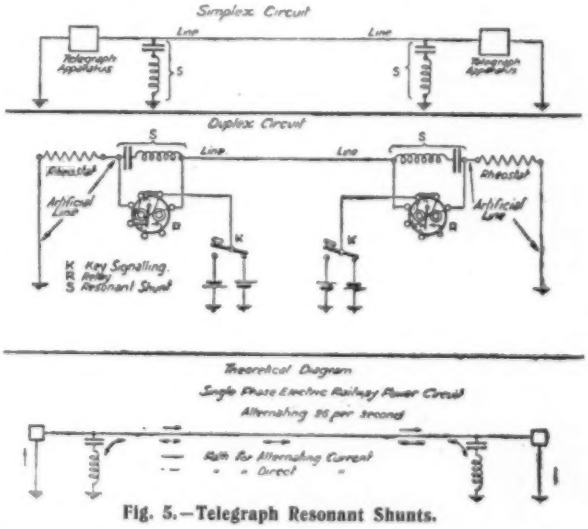


Fig. 5.—Telegraph Resonant Shunts.

from a three-phase 3,000-volt 50-period supply. Two rotary converters were by the same maker and of 600 kW and 300 kW respectively, and the third, by another maker, of 1,000 kW. The disturbance was found to be due to the latter machine only. Oscillograph records showed that the ripples superposed upon the direct current were of two frequencies, 1,200 and 300 per second, and of 30 and 40 volts r.m.s.; the 1,200-frequency ripple caused serious interference with the telephone service. Among other things the oscillograms showed that the main a.c. wave was free from objectionable ripples except when the 1,000-kW rotary converter was in use, indicating that the ripple originated with the converter and reacted on the a.c. side. In fig. 3 are copies of selected oscillograms taken before the machine was altered, followed by similar ones taken after the alterations to the machine, which had the effect of reducing the value of the ripples to about 5 volts r.m.s., the frequency being increased to over

2,000 per second, the result being that the interference was rendered inappreciable. The oscillograms showing the results when machines of the same type are worked in parallel, some having been altered and the others unaltered, indicate that the unaltered machines dominate the effects and that there is a marked change when the altered machines are run singly and in parallel. That the ripples originate in the generator, *i.e.*, the high-pressure a.c. side, and not in the rotary converter, does not appear to be the case in most instances, but it was definitely proved in one investigation by the Post Office that the sixth harmonic, which was present with the converter working normally, disappeared when the machine was driven from the starting motor.

Mercury arc rectifiers produce harmonics; telephone interference has been caused, but the trouble was successfully overcome. Prof. E. W. Marchant's advice was obtained, and the voltage variation was found to amount to plus or minus 9.5 per cent. of the average steady p.d. The voltage consisted of a ripple of about 300-cycle frequency, but there was also present a component of 600 cycles; the higher harmonics were relatively small. When the first two ripples were eliminated, the remaining higher-frequency harmonics caused no serious trouble.

For a single-phase rectifier a shunt was used consisting of inductance and capacity in series, and adjusted to be of zero reactance for the ripple frequency and so practically to short-circuit the rectifier for currents of ripple frequency. Instead of applying such a circuit to each arc circuit of the rectifier, it was decided to use a single circuit, tuned to the frequency of the resultant ripple of which the analysis is given. This arrangement (fig. 4) was found to be quite successful in dealing with the "6 arc" circuit, the ripple current through the shunt distributing itself along the different arc circuits in succession. If, however, this shunt circuit is used alone, a relatively large current of several hundred amperes will pass through it and through the different arcs, and the reduction in voltage variation will not be very marked. In order to limit the current, an additional single inductance coil L′ is placed in the main circuit of the rectifier, the currents through the various branches of the rectifier combining to flow through this inductance and being reduced to as small values as may be considered necessary.

(To be concluded.)

The Barton Power Station.*

By H. N. ALLOTT, M.Inst.C.E., and S. L. PEARCE, C.B.E., M.Inst.C.E.

The Barton power-station is the fourth to be built by the Manchester Corporation. Designs were completed in 1914, but progress of work was interrupted by the war, and plant was installed at the Stuart Street station, bringing the total capacity of the system up to 126,750 kW. Work on the new station was actually commenced in April, 1920. The site, comprising 14½ acres, is in Trafford Park, in close proximity to the Manchester Ship Canal. Within the limits available, the condensing water will be drawn from the Ship Canal, with the sewage and subsoil water from the Davyhulme sewage-works as a future additional source of supply. The site can accommodate about 165,000 kW of plant, whereof the first section consists of 82,500 kW. Red sandstone rock underlies the whole site; foundation work, therefore, did not present any special difficulty.

The buildings, generally, are of steel-frame construction, the walls being of brick, and the floors of concrete. The roofs are of girder construction, covered with reinforced-concrete slabs, and fitted with lanterns for lighting and ventilation. The basement of the boiler-house is at ground level, the firing-floor being placed at a height of 18 ft.

The floor carrying the draught plant, &c., in connection with the boilers is 43 ft. above the firing-floor. There are two firing-passages, and above each are the reinforced-concrete bunkers. The turbine-house has a basement 25 ft. deep for the condensing plant. The circulating water pump-house forms part of the turbine house basement, and the floor is about 36 ft. below ground level. The main switch and transformer house is a separate, three-storey building. The bottom floor contains the step-up transformers, oil-cooling plant, and 6,600-volt switchgear; the bus-bars and oil switches are installed on the first and second floors respectively.

The inlet chamber for the circulating water system is constructed of concrete, the bottom being 50 ft. below ground level. The water is drawn through three canals, each fitted with a grid screen and travelling perforated band screen, with penstocks for shutting off the water when required. The inlet chamber, pump-house sump, and outlet chamber are connected by culverts 9 ft. 6 in. in diameter, about 50 ft. below ground-level, the total length being about 2,400 ft. Six electrically-driven pumps are installed, two for each main condenser. The pumps, being below the water level of the Manchester Ship Canal, are constantly flooded. The outlet chamber is 100 ft. long by 21 ft. wide.

Storage is provided in silos for about 22,500 tons of fuel. Rail-borne fuel is delivered into hoppers on the viaduct. Bucket-type conveyors transfer the coal either direct to the bunkers or to the silos, for storage; they can also take coal from the silos to the bunkers. Canal-borne fuel is unloaded from the barges by means of two overhead travelling cranes, which can discharge the coal to the conveyors, to be deposited either in the coal bunkers or in the silos.

There are nine double-fired boilers of the marine type, each capable of evaporating 100,000 lb. of water per hour, actual, at their most efficient rating. They are designed to evaporate 120,000 lb. of water per hour during overload periods. Each boiler, with its stokers, superheaters, economisers, air-heaters, forced and induced draught fans, and chimney, is a complete unit in itself. The ashes are discharged into hoppers underneath the boilers. Standard gauge railway wagons and road transport wagons can be filled direct from these hoppers, thus dispensing with suction ash plants, or ash conveyors. The feed pipes have bolted joints, and the steam pipe joints are riveted, no jointing material being used in either case.

The first section of the station contains three 27,500-kW turbo-alternators, each capable of giving an output of 31,250 kW for a period of two hours. The condensers are of the contra-flow surface type, each set having "kinetic" and steam-jet extraction plants. The normal conditions for which the sets are designed are: Steam pressure, 350 lb. per sq. in. (gauge); steam temperature, 700 deg. F.; vacuum, 29.1 in.; voltage, 6,600; and speed, 1,500 r.p.m. Power for the station auxiliaries is furnished in part by three 420-volt house-service turbo-alternators, running at 3,000 r.p.m. Each alternator is ventilated on the closed-air-circuit principle. All the station auxiliaries, with the exception of three stand-by turbine-driven feed pumps, are electrically driven by 420-volt, a.c. motors, the load being distributed between the house-service alternators and three house-service transformers supplied from the 33,000-volt bus-bars.

Each main alternator is coupled direct to two three-phase transformers, each of 19,500 kVA capacity, which step up the pressure from 6,600 to 33,000 volts. The transformers are of the forced-oil-cooled type, each having its own oil-cooling equipment. The switchgear is laid out to control generating plant of 100,000 kW capacity, interconnected with a future station of the same size, and to existing stations. The circuits are divided into three groups, each comprising a main alternator, a house-service transformer and three or four feeders. These circuits are connected to duplicate bus-bars. A tie bus-bar is also employed, to which the main bus-bar is connected through reactors. The switchgear is of the cellular type.

Energy is transmitted from the Barton power-station into the Manchester area, also to the Lancashire Electric Power Co.'s and the Stretford Urban District Council's systems, by means of 0.3 sq. in., 3-core, 33,000-volt cables, laid direct in the ground.

Five sub-stations have been built in the Manchester area. Outgoing feeders from these centres continue the 33,000-volt supply to Middleton, Droylsden, Failsworth, and Salford. The switchgear in four of the sub-stations is of the armour-clad type, manufactured by two different firms. High Street sub-station is the first example of a large 33,000-volt outdoor sub-station in this country. There are seven 33,000-volt switchgear equipments, mounted on a reinforced-concrete structure. Mechanical gear has been fitted for operating the isolating links from ground level. The oil switches are of the tank type, and are remote electrically-controlled. Three 8,500-kVA, single-phase, outdoor transformer groups are also installed. Each transformer group is connected to induction-type voltage regulators. The 6,600-volt switchgear in this sub-station is of the cellular type. The switchgear at the Dickinson Street sub-station is of a new type, with duplicate bus-bars. Each equipment comprises two oil switches in one tank; these are remote electrically-controlled.

Full details of capital costs are given in an appendix.

* Abstract of a paper discussed at the Institution of Civil Engineers on April 15th.

Dalmarnock Electricity Works.*

By WILLIAM BURNSIDE, Assoc.M.Inst.C.E.

The Dalmarnock Electricity Works of Glasgow Corporation Electricity Department have a present capacity of 75,000 kW economical rating, with provision for a similar extension. Steam is generated at a pressure of 275 lb. per sq. in. by gauge, and at a total temperature of 700 deg. F. Current is generated at 6,500 volts, three-phase, 25 periods, and transformed to 20,000 volts for transmission.

About 700 tons of coal and about 9,000 tons of air for combustion per 24 hours are required for the present plant on a 50 per cent. load factor, the resulting ash being about 100 tons, and the make-up feed water for the same duty about 150 tons.

* Abstract of a paper discussed at the Institution of Civil Engineers on April 15th.

The ground at Dalmarnock, about 13½ acres, is on the right bank of the Clyde, at the eastern boundary of the city. An additional four acres has been acquired recently for railway sidings. The strata—clay, sand, and gravel—are mostly soft, and spread foundations, reinforced with steel under heavy point loads, were adopted. The maximum load on the ground is about 1½ tons per sq. ft. The subsurface works, consisting of water intakes and culverts, foundations, coal-filler pits, and pump chambers, are in concrete, plain and reinforced. With the exception of the roof of the turbine house, which is of steel, the structural members of the buildings and coal tanks are of reinforced concrete, with brickwork side, end, and division walls.

Two intakes from the river have been constructed, and a third is in course of construction. The water is controlled by sluices and cleaned by moving screens. The coal store is enclosed by reinforced-concrete retaining walls, and has a capacity of about 70,000 tons. It is commanded by a travelling transporter of 190-ft. span. The transporter carries a gravity bucket conveyor for storing, and a travelling crab with four-rope grab for reclaiming the coal. The coal-handling plant generally is of conveyor type, both gravity bucket and tray.

The two boiler houses abut on the turbine house at right angles. Each is 80 ft. wide and 149 ft. long, with three floors—a basement at yard level on which forced-draught plant and ash hoppers are situated; a firing floor, 15 ft. above the basement; and an economiser floor 29 ft. 6 in. higher. There is a row of four boilers on each side of each firing floor. The boilers have each a normal capacity of 50,000 lb. of water evaporated per hour with feed water at 150 deg. F. The stokers are of chain-grate type and both forced- and induced-draught plant is provided. The furnace gases are passed through economisers to steel chimneys lined with cement plaster on "Hy-rib." There is one chimney, 9½ ft. in diameter, and one induced-draught fan to each two boilers, and a forced-draught fan to each boiler. There are two feed pumps to each line of four boilers. They form duplicates, and have each a capacity of 20,000 gal. per hour against a total head of 340 lb. per sq. in. One pump is a steam centrifugal, and the other a motor-driven multi-stage centrifugal. Suction ash and soot plant is installed.

The turbine house is 75 ft. clear between columns, 230 ft. long, and is served by a 75-ton overhead electric travelling crane. The condenser on the basement floor is 11 ft. below yard level; the turbine floor is 26 ft., and the crane-rail level 54 ft., above the basement.

There are five 15,000-kW, 1,500-r.p.m., turbo-alternator sets, designed for steam at 250 lb. per sq. in. by gauge, and 650 deg. F.; vacuum 29.1 in., with barometer at 30 in. The surface condensers each have a condensing area of 26,000 sq. ft. and a capacity of 160,000-200,000 lb. of steam per hour. There is a 36-in. horizontal centrifugal circulating water pump to each set. Motor-driven and ejector auxiliaries are installed in different machines. The alternators are rated at 18,750 kW at 0.8 power factor. Each requires 70,000 cu. ft. of air per minute for ventilation, which is cleaned and cooled by wet-air filters—two to each machine.

The switch house is alongside the turbine house. There are three single-phase oil-cooled transformers to each generating set, on the lower floor. The high-pressure switchgear, of oil-immersed ironclad type, is on the upper floor. The control room is at one end, and switch operation is by solenoid operated from the control room.

With the exception of the turbine feed pumps, all the auxiliaries are motor-driven. The current is 440 volts, three-phase, 25 periods, from various sources—two house turbo-generators, two house transformers 20,000/440 volts, and tappings in three machines from low-pressure windings on the step-up transformers. The condensate is heated in various ways and enters the drums at a temperature of about 270 deg. F. The two house turbines exhaust into open-type heaters through which the condensate is passed; the steam from the condenser steam ejectors is dealt with similarly; steam is bled from turbines Nos. 2 to 5 for low-pressure heaters, and the exhaust from turbine pumps is discharged through nozzles into the hot wells.

The working results, in spite of a load factor of only about 34 per cent., are among the best in the country. The quantity of coal used per kWh generated is generally about 1.78 lb., and the thermal efficiency is about 18 per cent. The capital cost up to May 31st, 1923, was £1,903,649, made up as follows:—

	£	Per cent.
Land	72,807	3.8
Buildings	511,381	26.8
Electrical plant	417,977	21.9
Steam plant	819,476	43.1
Coal and ash-handling plant ...	51,739	2.8
Cranes	24,525	1.2
Accumulators	5,744	0.4
	1,903,649	100.0

The works were designed and carried out under the supervision of the engineering staff of the Department, first under Mr. W. W. Lackie, C.B.E., M.Inst.C.E., now one of H.M. Electricity Commissioners, and afterwards under Mr. R. B. Mitchell, the present chief engineer.

Legal.

Attorney-General v. Ealing Corporation.

THIS action came before Mr. Justice Romer in the Chancery Division on April 7th.

Mr. FARWELL, K.C., who appeared with Mr. Dighton Pollock, for the Attorney-General, said that he sought a declaration that the defendants were not at any time entitled to extend the generating plant at their electricity works by the installation of a new turbine generating plant without the consent of the Electricity Commissioners. That was a question which arose almost entirely upon one section of the Electricity Act, 1919, and it was a question of fact, *viz.*, whether what the defendants had done was an extension of their generating-plant having regard to the definition of a generating station in the Act. If his Lordship held that it was an extension, then, said Mr. Farwell, he did not think it would be disputed that the consent of the Commissioners was necessary, and it was admitted that no consent had been asked for. He was also asking for a declaration that the payments for the new plant out of the accumulated profits of the undertaking were *ultra vires*. He would ask for an injunction to prevent the commission of what was an illegal act and an order on the defendants to restore the generating station to the condition in which it was before the new plant was purchased, but such an order as would prevent the inhabitants of Ealing being left in darkness.

Mr. T. R. HUGHES, K.C., who with Mr. S. G. Turner appeared for the defendants, said that the thing had been done long ago, and the old plant had been scrapped, so that it was impossible to restore the station to its previous state.

Mr. FARWELL said that it was important from the point of view of the public and the Commissioners to get a decision whether in a case of this kind the installation of new plant was an extension of the generating station within the meaning of the Act so that injunction could be obtained in other cases where necessary. If an undertaking could do as he said had been done here, *viz.*, ask advice of the Commissioners, get it, and then proceed to do as the defendants had done, the difficulties of the Commissioners would be immeasurably increased.

His LORDSHIP: It would not improve the position of the ratepayers to make a mandatory order, and it does not appear to be necessary for the purpose of protecting the Commissioners.

Mr. FARWELL said that the Ealing Local Board was empowered in 1891 by Provisional Order to supply electricity within the area, and under that Order the defendants had set up and maintained their generating station. Until last year the total capacity of the plant was 2,520 kW. Then the system was arranged to supply an alternating current of 40 cycles per second. This was material because he was informed that Ealing was the only station where a 40-cycle system was in use. All the other generating stations in the area of London and the Home Counties employed the 50-cycle system, and it was not possible to combine the two. As the Commissioners had decided that the 50-cycle system was the proper one to be adopted in the area, to have another system would be inconvenient. Last year the defendants removed a portion of their plant of a total capacity of 300 kW and installed in its place a new generating set with a total capacity of 2,000 kW, with the result that their total capacity now was 1,700 kW more than it was before the alteration was made, and the cost was about £20,000.

On April 8th, Mr. Farwell outlined the Commissioners' powers under the Act of 1919, and said that in the scheme for the reorganisation of supply in London the Ealing station was one of those which were to be closed down. Section 11 of the Act made it unlawful for any statutory authority to extend its station without the Commissioners' permission, and he (counsel) held that this applied not only to the extension of buildings, but of machinery. The Commissioners had ruled that a bulk supply should be taken from the Metropolitan Electric Supply Co., Ltd., but the Corporation was unable to come to terms with the company, and, later, arranged a provisional agreement with the Hammersmith Borough Council for a supply from that authority's station. The Commissioners refused to sanction this, and an application by Ealing Corporation to the High Court for a *mandamus* calling upon the Commissioners to reconsider the application was unsuccessful. The matter was then apparently dropped until early last year, when the Commissioners were informed by the Town Clerk of Ealing that the Corporation had scrapped seven old generating sets and installed a turbo-generating set, which was more efficient and occupied less space. The Commissioners held this action to be a breach of the Act.

Sir JOHN SNELL gave evidence with regard to the old plant and the new set.

Mr. HUGHES, opening the case for the defence, said that when the demand upon the Ealing Corporation's station reached 75 per cent. of the capacity, it was considered that immediate provision should be made for increasing the supply. The price demanded by the Metropolitan Co. for a supply was far too high, and accordingly the Hammersmith Council was approached. The Council offered a bulk supply at the price of 1d. per kWh, as compared with the company's 1½d. per kWh or thereabouts. When the Commissioners refused

to sanction the agreement with Hammersmith, defendants resolved to replace their old plant with new and more efficient plant, and he (counsel) contended that this was not an extension but merely the replacement of obsolete and uneconomical plant. It was a contradiction in terms to say that the station was extended when, in fact, the plant was reduced in size.

Mr. J. D. KNIGHT, defendants' electrical engineer, gave details of the plant, old and new, and said that it would be impossible to restore the old plant.

Sir PATRICK HASTINGS (Attorney-General) asked witness if it were not the fact that the total works cost per kWh at Ealing in 1922-23 was 3.96d., while for other undertakings in the area it was 1.29d. Mr. Knight agreed, but said that the loads were very different. Ealing was purely a residential neighbourhood, while other undertakings had industrial loads.

After the Attorney-General had replied to the points raised for the defence, his Lordship said that he would deliver judgment in writing in the course of a few days.

Mr. Justice Romer delivered judgment on April 14th. He said that it was clear that although the defendants claimed that the Act forbade only the extension of buildings, or, alternatively, that they had not extended their plant, they had committed a breach of Section 11 of the Act. The capacity had been increased and that, he held, was an extension. The object of the Act was to secure that the Commissioners in reorganising electricity supply should not be embarrassed by the establishment or extension of stations without their consent. His Lordship also held that the cost of the plant (£20,000) must be a charge on capital and not on the profits of the undertaking.

Attorney-General v. Southport Corporation.

THIS case, which has been reported in our columns from time to time, reached a further stage last week, when the defendants appealed to the House of Lords against the decision of the Court of Appeal. It will be remembered that the action was taken by the Attorney-General at the relation of the Birkdale District Electric Supply Co. to obtain an injunction restraining the defendants from supplying electricity in the urban district of Birkdale. This district was taken in by the Southport Corporation by an Act of Parliament, and there existed an agreement between the former local authority and the supply company by which the latter secured the sole right to distribute electricity in the district. The Corporation had supplied energy for tramways and public lighting in the district, and Mr. Justice Eve considered that it was acting within its rights, and dismissed the action. The Court of Appeal, however, reversed this decision, holding that the word "supply" in the agreement comprised *any* supply, public or private. The Corporation is now appealing against this judgment.

The hearing was concluded on April 10th; their Lordships reserved judgment.

Metropolitan-Vickers Electrical Co., Ltd., v. United Alkali Co., Ltd.

BEFORE Mr. Justice Tomlin, in the Chancery Division on April 11th, plaintiffs asked for an injunction against the defendants restraining an infringement of a patent.

Mr. MORITZ, for the plaintiffs, said that the patent related to a combination comprising a turbine, a boiler, a condenser, and a feed-water heater, and the defendants had submitted to a perpetual injunction, but without any inquiry as to damages. They wished him to say, however, that their infringement was quite innocent, as they bought the plant from others, not knowing of the plaintiffs' patent.

His Lordship acted accordingly.

Action by St. Pancras Borough Council.

THE Parliamentary and General Purposes Committee of the St. Pancras Borough Council reports that some time ago Messrs. Hulton & Co., Ltd., applied for a supply of electricity for their premises in Gray's Inn Road. After long negotiations the company intimated that it had contracted with the County of London Electric Supply Co., Ltd., to obtain the electrical energy required. The firm's premises stand partly in the Council's area of supply and partly in that of the County of London Co.; the part in the Council's area, however, is about three-fourths of the building or more. The committee is advised that the County of London Co. is not in order in supplying electricity to that portion of Messrs. Hulton's premises which is in the Council's area of supply. Application has therefore been made to the Attorney-General for his *fiat* with a view to the commencement of legal proceedings.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

AT the conclusion of the arguments on behalf of the appellants, Sir ARTHUR COLEFAX, K.C., supported the judgment of Mr. Justice Russell on behalf of the plaintiffs. He contended that there was no disclosure in the 1906 patent of the invention covered by the 1909 patent, and that before the publication of the latter patent no one had produced a body of tungsten ductile cold nor had anyone produced a drawn tungsten wire filament. He submitted that the 1909 invention was proper subject matter for letters patent and that the defences of want of novelty and want of subject matter failed.

Sir Arthur Colefax continued his presentation of respondents' case on April 14th.

It is not expected that the arguments will conclude during the present sittings.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

26,087. "Electric cooking grill." M. Tocchio. June 7th, 1923. (212,953.)

31,252. "Electron discharge devices and methods of operating same." British Thomson-Houston Co., Ltd. November 15th, 1921. (189,135.)

34,181. "Method and system for transmitting pictures to a distance." Picturadio Corporation." June 13th, 1922. (199,349.)

34,587. "Electrical connectors." H. J. Fisher. December 19th, 1922. (212,983.)

34,639. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., C. Gillings, and W. O. Passmore. December 19th, 1922. (Cognate application 768/23.) (212,985.)

34,854. "Production of thermo-induction currents." E. Viz and M. Meinhardt. December 21st, 1922. (Addition to 198,722.) (212,995.)

34,868. "Lehrs." H. Wade (H. L. Dixon Co.). December 21st, 1922. (212,997.)

34,870. "Electrically-heated furnaces or lehrs." H. Wade (H. L. Dixon Co.). December 21st, 1922. (212,998.)

35,050. "Electric insulators." W. H. Eccles. December 23rd, 1922. (Cognate application 942/23.) (213,005.)

35,155. "Sensitive elements of relays and the like." Barr & Stroud, Ltd., and J. W. French. December 27th, 1922. (213,012.)

35,202. "Electrolytic method and syphon." E. C. R. Marks (Locomotive Firebox Co.). December 27th, 1922. (213,013.)

1923.

161. "Electric circuit-breaker systems." British Thomson-Houston Co., Ltd. (General Electric Co.). January 2nd, 1923. (213,020.)

372. "High-frequency signalling systems." British Thomson-Houston Co., Ltd. January 5th, 1922. (191,390.)

440. "Variable electric resistances and inductances." R. H. Winter. January 5th, 1923. (213,030.)

474. "Vacuum tubes of the 'audion' type." F. Peri. October 7th, 1922. (205,038.)

515. "Safety switchgear for automobiles and the like." C. W. Cook. January 6th, 1923. (Cognate application 21,598/23.) (213,033.)

637. "Radio-frequency transmission systems." A. P. M. Fleming, S. J. Nightingale, J. W. Buckley, A. O. Rankine, and Metropolitan-Vickers Electrical Co., Ltd. January 8th, 1923. (213,034.)

938. "Amplifying apparatus for wireless telegraphy and telephony." D. S. B. Shannon. January 11th, 1923. (213,036.)

1,003. "Synchronous electric motors." L. H. A. Carr and Metropolitan-Vickers Electrical Co., Ltd. January 11th, 1923. (213,037.)

2,920. "Automatic reclosing electric circuit-breaker systems." British Thomson-Houston Co., Ltd. April 15th, 1922. (196,246.)

3,011. "Sound boxes of sound-recording or sound-reproducing instruments." M. A. Renison. February 1st, 1923. (213,058.)

3,236. "Telephone systems." H. S. Conrad. February 3rd, 1923. (213,063.)

3,591. "Methods of transmitting multiphase alternating electric currents through separate cables for each phase." B. S. Hornby. February 7th, 1923. (213,065.)

3,624. "Electrically-heated water boilers." Jackson Boilers, Ltd., and H. Hargreaves. February 7th, 1923. (213,066.)

3,750. "Tuning coils used in connection with wireless telegraphy and telephony." W. H. Hunter. February 8th, 1923. (213,069.)

4,023. "Switching apparatus for telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 10th, 1923. (213,072.)

4,813. "Dry cells, and the manufacture of same." G. Weissmann. February 19th, 1923. (213,082.)

4,962. "Variable leaks for use in connection with thermionic valves." A. H. Hunt. February 20th, 1923. (213,084.)

5,499. "Manufacture of acetate of alumina by electrolysis." H. Cruse. February 26th, 1923. (213,088.)

5,844. "Means and methods of magnetic and electric measurements in electrical conductors." Western Electric Co., Ltd. October 24th, 1922. (206,104.)

6,066. "Electricity meters." R. Amberton. March 2nd, 1923. (213,091.)

6,884. "Electrical measuring instruments." K. Edgcumbe, E. I. Everett, and F. E. J. Ockenden. March 9th, 1923. (Addition to 204,798.) (213,098.)

7,067. "Electric motors." T. Yamanoto. March 12th, 1923. (213,099.)

8,106. "Thermionic valves and the like." W. E. Barber. March 21st, 1923. (213,113.)

10,242. "Suspension insulators for electrical transmission lines." Soc. Ceramica Richard-Ginori. April 20th, 1922. (196,604.)

10,243. "Suspension insulators for transmission lines." Soc. Ceramica Richard-Ginori. November 15th, 1922. (207,147.)

11,009. "Production of artificial filaments." L. A. Levy. April 23rd, 1923. (213,138.)

11,580. "Device to be fixed to clocks for the opening and closing of an electric circuit." B. W. Hecht (S. Kaufman). April 30th, 1923. (213,144.)

12,994. "Methods of improving the efficiency of frequency-multiplying transformers." W. Dornig. August 9th, 1922. (202,277.)

13,776. "Electric cables." J. B. Gall and Callender's Cable & Construction Co., Ltd. May 24th, 1923. (213,153.)

14,152. "Electric motor control systems for electric cars and locomotives." E. J. Ondoli. May 29th, 1923. (213,155.)

18,219. "Joint for electrical conductors." H. W. Lundin. July 14th, 1923. (213,178.)

21,490. "Electric locomotives for mixed toothed wheel and adhesion drives." Akt. Ges. Brown, Boveri et Cie. May 22nd, 1923. (213,186.)

21,841. "Selective or anti-parasitic system for the reception of constant frequency electromagnetic waves or electric currents." Marrec, Ltd., and Y. Marrec. September 6th, 1922. (203,678.)

1924.

454. "Diaphragms for sound-emitting instruments." British Thomson-Houston Co., Ltd., J. H. Butcher, and A. P. Young. December 14th, 1922. (Divided application on 212,648.) (213,211.)

1,879. "Means for compensating electromotive forces due to self-induction." J. Bethenod. January 25th, 1923. (210,435.)